

General

Guideline Title

2012 ACCF/AHA/HRS focused update incorporated into the ACCF/AHA/HRS 2008 guidelines for device-based therapy of cardiac rhythm abnormalities. A report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines and the Heart Rhythm Society.

Bibliographic Source(s)

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Guideline Status

This is the current release of the guideline.

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Recommendations

Major Recommendations

Definitions for the level of evidence (A-C) and classification of recommendations (I-III) are provided at the end of the "Major Recommendations" field.

Note from the National Guideline Clearinghouse (NGC) and the American College of Cardiology Foundation/American Heart
Association (ACCF/AHA) Task Force on Practice Guidelines: In 2012, the ACCF/AHA Task Force performed a focused update of the 2008 guidelines for device-based therapy of cardiac rhythm abnormalities to revise existing guideline recommendations that are affected by evolving data or opinion. The updated recommendations are presented below, along with the original 2008 recommendations. Sections affected by the focused

update are labeled "2012 Focused Update." All other recommendations remain current in their 2008 form.

Indications for Pacing

Recommendations for Permanent Pacing in Sinus Node Dysfunction (SND)

Class I

- 1. Permanent pacemaker implantation is indicated for SND with documented symptomatic bradycardia, including frequent sinus pauses that produce symptoms (Kay, Estioko, & Wiener, 1982; Kusumoto & Goldschlager, 1996; Rasmussen, 1981). (Level of Evidence: C)
- 2. Permanent pacemaker implantation is indicated for symptomatic chronotropic incompetence (Kay, Estioko, & Wiener, 1982; Kusumoto & Goldschlager, 1996; Rasmussen, 1981; Linde-Edelstam et al., 1992; Gammage et al., 1991). (Level of Evidence: C)
- 3. Permanent pacemaker implantation is indicated for symptomatic sinus bradycardia that results from required drug therapy for medical conditions. (Level of Evidence: C)

Class IIa

- Permanent pacemaker implantation is reasonable for SND with heart rate less than 40 beats per minute (bpm) when a clear association between significant symptoms consistent with bradycardia and the actual presence of bradycardia has not been documented (Kay, Estioko, & Wiener, 1982; Kusumoto & Goldschlager, 1996; Rasmussen, 1981; Shaw, Holman, & Gowers, 1980; Dreifus, Michelson, & Kaplinsky, 1983; Rubenstein et al., 1972). (Level of Evidence: C)
- 2. Permanent pacemaker implantation is reasonable for syncope of unexplained origin when clinically significant abnormalities of sinus node function are discovered or provoked in electrophysiological studies (Fisher, 1981; Reiffel & Kuehnert, 1994). (Level of Evidence: C)

Class IIb

1. Permanent pacemaker implantation may be considered in minimally symptomatic patients with chronic heart rate less than 40 bpm while awake (Kay, Estioko, & Wiener, 1982; Rasmussen, 1981; Linde-Edelstam et al., 1992; Shaw, Holman, & Gowers, 1980; Dreifus, Michelson, & Kaplinsky, 1983; Rubenstein et al., 1972). (Level of Evidence: C)

Class III

- 1. Permanent pacemaker implantation is not indicated for SND in asymptomatic patients. (Level of Evidence: C)
- 2. Permanent pacemaker implantation is not indicated for SND in patients for whom the symptoms suggestive of bradycardia have been clearly documented to occur in the absence of bradycardia. (Level of Evidence: C)
- 3. Permanent pacemaker implantation is not indicated for SND with symptomatic bradycardia due to nonessential drug therapy. (Level of Evidence: C)

Recommendations for Acquired Atrioventricular (AV) Block in Adults

Class I

- Permanent pacemaker implantation is indicated for third-degree and advanced second-degree AV block at any anatomic level associated with bradycardia with symptoms (including heart failure) or ventricular arrhythmias presumed to be due to AV block (Dreifus, Michelson, & Kaplinsky, 1983; Friedberg, Donoso, & Stein, 1964; "Recommendations for pacemaker prescription," 1991; Kastor, 1975). (Level of Evidence: C)
- Permanent pacemaker implantation is indicated for third-degree and advanced second-degree AV block at any anatomic level associated with arrhythmias and other medical conditions that require drug therapy that results in symptomatic bradycardia (Dreifus, Michelson, & Kaplinsky, 1983; Friedberg, Donoso, & Stein, 1964; "Recommendations for pacemaker prescription," 1991; Kastor, 1975). (Level of Evidence: C)
- 3. Permanent pacemaker implantation is indicated for third-degree and advanced second-degree AV block at any anatomic level in awake, symptom-free patients in sinus rhythm, with documented periods of asystole greater than or equal to 3.0 seconds (Ector, Rolies, & De Geest, 1983) or any escape rate less than 40 bpm, or with an escape rhythm that is below the AV node (Kay, Estioko, & Wiener, 1982; Shaw, Holman, & Gowers, 1980). (Level of Evidence: C)
- 4. Permanent pacemaker implantation is indicated for third-degree and advanced second-degree AV block at any anatomic level in awake, symptom-free patients with atrial fibrillation (AF) and bradycardia with 1 or more pauses of at least 5 seconds or longer. (Level of Evidence: C)
- 5. Permanent pacemaker implantation is indicated for third-degree and advanced second-degree AV block at any anatomic level after catheter ablation of the AV junction (Gallagher et al., 1982; Langberg et al., 1989). (Level of Evidence: C)

- Permanent pacemaker implantation is indicated for third-degree and advanced second-degree AV block at any anatomic level associated with postoperative AV block that is not expected to resolve after cardiac surgery (Kim et al., 2001; Kastor, 1975; Glikson et al., 1997; Koplan et al., 2003). (Level of Evidence: C)
- 7. Permanent pacemaker implantation is indicated for third-degree and advanced second-degree AV block at any anatomic level associated with neuromuscular diseases with AV block, such as myotonic muscular dystrophy, Kearns-Sayre syndrome, Erb dystrophy (limb-girdle muscular dystrophy), and peroneal muscular atrophy, with or without symptoms (Perloff et al., 1984; Hiromasa et al., 1987; Stevenson et al., 1990; James & Fisch, 1963; Roberts, Perloff, & Kark, 1979; Charles et al., 1981; James, 1962). (Level of Evidence: B)
- 8. Permanent pacemaker implantation is indicated for second-degree AV block with associated symptomatic bradycardia regardless of type or site of block (Strasberg et al., 1981). (Level of Evidence: B)
- 9. Permanent pacemaker implantation is indicated for asymptomatic persistent third-degree AV block at any anatomic site with average awake ventricular rates of 40 bpm or faster if cardiomegaly or left ventricular (LV) dysfunction is present or if the site of block is below the AV node ("Recommendations for pacemaker prescription," 1981; Shaw et al., 1985). (Level of Evidence: B)
- 10. Permanent pacemaker implantation is indicated for second- or third-degree AV block during exercise in the absence of myocardial ischemia (Chokshi et al., 1990; Barold & Mugica, 1991). (Level of Evidence: C)

Class IIa

- Permanent pacemaker implantation is reasonable for persistent third-degree AV block with an escape rate greater than 40 bpm in asymptomatic adult patients without cardiomegaly (Dreifus, Michelson, & Kaplinsky et al., 1983; Friedberg, Donoso, & Stein, 1964; Gadboys, Wisoff, & Litwak, 1964; "Recommendations for pacemaker prescription," 1991; Barold & Mugica, 1991; Kastor, 1975). (Level of Evidence: C)
- 2. Permanent pacemaker implantation is reasonable for asymptomatic second-degree AV block at intra- or infra-His levels found at electrophysiological study (Strasberg et al., 1981; "Recommendations for pacemaker prescription," 1991; Shaw et al., 1985). (Level of Evidence: B)
- 3. Permanent pacemaker implantation is reasonable for first- or second-degree AV block with symptoms similar to those of pacemaker syndrome or hemodynamic compromise (Barold, 1996; Kim et al., 1993). (Level of Evidence: B)
- 4. Permanent pacemaker implantation is reasonable for asymptomatic type II second-degree AV block with a narrow QRS. When type II second-degree AV block occurs with a wide QRS, including isolated right bundle-branch block, pacing becomes a Class I recommendation (see Section 2.1.3, "Chronic Bifascicular Block," in the original guideline document) (Barold, 1996; "Recommendations for pacemaker prescription," 1991; Zipes, 1979; Kastor, 1975). (Level of Evidence: B)

Class IIb

- 1. Permanent pacemaker implantation may be considered for neuromuscular diseases such as myotonic muscular dystrophy, Erb dystrophy (limb-girdle muscular dystrophy), and peroneal muscular atrophy with any degree of AV block (including first-degree AV block), with or without symptoms, because there may be unpredictable progression of AV conduction disease (Perloff et al., 1984; Hiromasa et al., 1987; Stevenson et al., 1990; James & Fisch, 1963; Roberts, Perloff, & Kark, 1979; Charles et al., 1981; James, 1962). (Level of Evidence: B)
- 2. Permanent pacemaker implantation may be considered for AV block in the setting of drug use and/or drug toxicity when the block is expected to recur even after the drug is withdrawn (Zeltser et al., 2004; Shohat-Zabarski et al., 2004). (Level of Evidence: B)

Class III

- 1. Permanent pacemaker implantation is not indicated for asymptomatic first-degree AV block (see Section 2.1.3, "Chronic Bifascicular Block," in the original guideline document) (Mymin et al., 1986). (Level of Evidence: B)
- 2. Permanent pacemaker implantation is not indicated for asymptomatic type I second-degree AV block at the supra-His (AV node) level or that which is not known to be intra- or infra-Hisian (Strasberg et al., 1981). (Level of Evidence: C)
- 3. Permanent pacemaker implantation is not indicated for AV block that is expected to resolve and is unlikely to recur (McAlister et al., 1989) (e.g., drug toxicity, Lyme disease, or transient increases in vagal tone or during hypoxia in sleep apnea syndrome in the absence of symptoms) (Shohat-Zabarski et al., 2004; McAlister et al., 1989). (Level of Evidence: B)

Recommendations for Permanent Pacing in Chronic Bifascicular Block

Class I

1. Permanent pacemaker implantation is indicated for advanced second-degree AV block or intermittent third-degree AV block (Friedberg, Donoso, & Stein, 1964; Gadboys, Wisoff, & Litwak, 1964; Johansson, 1966; Hindman et al., 1978; Donmoyer, DeSanctis, & Austen, 1967; Edhag & Swahn, 1976; Levine, Millier, & Penton, 1956). (Level of Evidence: B)

- 2. Permanent pacemaker implantation is indicated for type II second-degree AV block (Dhingra et al., "The significance," 1974; Donoso, Adler, & Friedberg, 1964; Ranganathan et al., 1972; Dhingra et al., "Syncope," 1974). (Level of Evidence: B)
- 3. Permanent pacemaker implantation is indicated for alternating bundle-branch block (Josephson, 1993). (Level of Evidence: C)

Class IIa

- 1. Permanent pacemaker implantation is reasonable for syncope not demonstrated to be due to AV block when other likely causes have been excluded, specifically ventricular tachycardia (VT) (Fisch, Zipes, & Fisch, 1980; McAnulty et al., 1982; Kulbertus & Collignon, 1969; DePasquale & Bruno, 1973; Denes et al., 1977; McAnulty et al., 1978; Peters et al., 1979; Scheinman et al., 1982; Morady et al., 1984; Click et al., 1987; Ezri et al., 1983; Twidale et al., 1988; Englund et al., 1995; Scheinman et al., 1977; Probst et al., 1979; Dhingra et al., 1979; Cheng, 1971; Dhingra et al., "Syncope," 1974; Brignole et al., 2001). (Level of Evidence: B)
- 2. Permanent pacemaker implantation is reasonable for an incidental finding at electrophysiological study of a markedly prolonged HV interval (greater than or equal to 100 milliseconds) in asymptomatic patients (Scheinman et al., 1982). (Level of Evidence: B)
- 3. Permanent pacemaker implantation is reasonable for an incidental finding at electrophysiological study of pacing-induced infra-His block that is not physiological (Dhingra et al., 1979). (Level of Evidence: B)

Class IIb

1. Permanent pacemaker implantation may be considered in the setting of neuromuscular diseases such as myotonic muscular dystrophy, Erb dystrophy (limb-girdle muscular dystrophy), and peroneal muscular atrophy with bifascicular block or any fascicular block, with or without symptoms (Perloff et al., 1984; Hiromasa et al., 1987; Stevenson et al., 1990; James & Fisch, 1963; Roberts, Perloff, & Kark, 1979; Charles et al., 1981; James, 1962). (Level of Evidence: C)

Class III

- 1. Permanent pacemaker implantation is not indicated for fascicular block without AV block or symptoms (McAnulty et al., 1982; McAnulty et al., 1978; Scheinman et al., 1982; Scheinman et al., 1977). (Level of Evidence: B)
- 2. Permanent pacemaker implantation is not indicated for fascicular block with first-degree AV block without symptoms (McAnulty et al., 1982; McAnulty et al., 1978; Scheinman et al., 1982; Scheinman et al., 1977). (Level of Evidence: B)

Recommendations for Permanent Pacing After the Acute Phase of Myocardial Infarction (MI)*

Class I

- 1. Permanent ventricular pacing is indicated for persistent second-degree AV block in the His-Purkinje system with alternating bundle-branch block or third-degree AV block within or below the His-Purkinje system after ST-segment elevation MI (Ranganathan et al., 1972; Col & Weinberg, 1972; Ritter et al., 1976; Ginks et al., 1977; Domenighetti & Perret, 1980; Lamas et al., 1986). (Level of Evidence: B)
- Permanent ventricular pacing is indicated for transient advanced second- or third-degree infranodal AV block and associated bundle-branch block. If the site of block is uncertain, an electrophysiological study may be necessary (Col & Weinberg, 1972; Ritter et al., 1976). (Level of Evidence: B)
- 3. Permanent ventricular pacing is indicated for persistent and symptomatic second- or third-degree AV block. (Level of Evidence: C)

Class IIb

1. Permanent ventricular pacing may be considered for persistent second- or third-degree AV block at the AV node level, even in the absence of symptoms (Shaw, Holman, & Gowers, 1980). (Level of Evidence: B)

Class III

- 1. Permanent ventricular pacing is not indicated for transient AV block in the absence of intraventricular conduction defects (Col & Weinberg, 1972). (Level of Evidence: B)
- 2. Permanent ventricular pacing is not indicated for transient AV block in the presence of isolated left anterior fascicular block (Ginks et al., 1977). (Level of Evidence: B)
- 3. Permanent ventricular pacing is not indicated for new bundle branch block or fascicular block in the absence of AV block (Hindman et al., 1978; Col & Weinberg, 1972). (Level of Evidence: B)
- 4. Permanent ventricular pacing is not indicated for persistent asymptomatic first-degree AV block in the presence of bundle branch or fascicular block (Col & Weinberg, 1972). (Level of Evidence: B)

^{*}These recommendations are consistent with the "American College of Cardiology (ACC)/AHA Guidelines for the Management of Patients with ST-Elevation Myocardial Infarction"

(Antman et al., 2004).

Recommendations for Permanent Pacing in Hypersensitive Carotid Sinus Syndrome and Neurocardiogenic Syncope

Class I

1. Permanent pacing is indicated for recurrent syncope caused by spontaneously occurring carotid sinus stimulation and carotid sinus pressure that induces ventricular asystole of more than 3 seconds (Brignole et al., 1992; Brignole et al., 1991). (Level of Evidence: C)

Class IIa

1. Permanent pacing is reasonable for syncope without clear, provocative events and with a hypersensitive cardioinhibitory response of 3 seconds or longer (Brignole et al., 1992). (Level of Evidence: C)

Class IIb

1. Permanent pacing may be considered for significantly symptomatic neurocardiogenic syncope associated with bradycardia documented spontaneously or at the time of tilt-table testing (Sutton et al., 2000; Ammirati, Colivicchi, & Santini, 2001; Connolly et al., 2003; Sheldon et al., 1998). (Level of Evidence: B)

Class III

- 1. Permanent pacing is not indicated for a hypersensitive cardioinhibitory response to carotid sinus stimulation without symptoms or with vague symptoms. (Level of Evidence: C)
- 2. Permanent pacing is not indicated for situational vasovagal syncope in which avoidance behavior is effective and preferred. (Level of Evidence: C)

Recommendations for Pacing After Cardiac Transplantation

Class I

1. Permanent pacing is indicated for persistent inappropriate or symptomatic bradycardia not expected to resolve and for other Class I indications for permanent pacing. (Level of Evidence: C)

Class IIb

- 1. Permanent pacing may be considered when relative bradycardia is prolonged or recurrent, which limits rehabilitation or discharge after postoperative recovery from cardiac transplantation. (Level of Evidence: C)
- 2. Permanent pacing may be considered for syncope after cardiac transplantation even when bradyarrhythmia has not been documented. (Level of Evidence: C)

Recommendations for Permanent Pacemakers That Automatically Detect and Pace to Terminate Tachycardias

Class IIa

1. Permanent pacing is reasonable for symptomatic recurrent supraventricular tachycardia (SVT) that is reproducibly terminated by pacing when catheter ablation and/or drugs fail to control the arrhythmia or produce intolerable side effects (Peters et al., 1985; Fisher et al., "Long-term efficacy," 1987; Den Dulk et al., 1984; Saksena et al., 1986; Barold et al., 1987). (Level of Evidence: C)

Class III

1. Permanent pacing is not indicated in the presence of an accessory pathway that has the capacity for rapid anterograde conduction. (Level of Evidence: C)

Recommendations for Pacing to Prevent Tachycardia

Class I

1. Permanent pacing is indicated for sustained pause-dependent VT, with or without QT prolongation (Eldar et al., 1987; Eldar et al., 1992). (Level of Evidence: C)

Class IIa

1. Permanent pacing is reasonable for high-risk patients with congenital long-QT syndrome (Eldar et al., 1987; Eldar et al., 1992). (Level of Evidence: C)

Class IIb

1. Permanent pacing may be considered for prevention of symptomatic, drug-refractory, recurrent AF in patients with coexisting SND (Lamas et al., 2000; Saksena et al., 1996; Saksena et al., 1998). (Level of Evidence: B)

Class III

- 1. Permanent pacing is not indicated for frequent or complex ventricular ectopic activity without sustained VT in the absence of the long-QT syndrome (Fisher et al., "Antiarrhythmic effects," 1987). (Level of Evidence: C)
- 2. Permanent pacing is not indicated for torsade de pointes VT due to reversible causes (Moss & Robinson, 1992; Viskin et al., 1996). (Level of Evidence: A)

Recommendation for Pacing to Prevent Atrial Fibrillation

Class III

1. Permanent pacing is not indicated for the prevention of AF in patients without any other indication for pacemaker implantation (Knight et al., 2005). (Level of Evidence: B)

Recommendations for Cardiac Resynchronization Therapy (CRT) (Updated)

See "Indications for CRT Therapy—Algorithm" in Appendix 6 of the original guideline document.

Class I

 CRT is indicated for patients who have left ventricular ejection fraction (LVEF) less than or equal to 35%, sinus rhythm, left bundle-branch block (LBBB) with a QRS duration greater than or equal to 150 ms, and New York Heart Association (NYHA) class II (Moss et al., 2009; Tang et al., 2010), III, or ambulatory IV (Abraham et al., 2002; Bristow et al., 2004; Cleland et al., 2005; Goldstein et al., 2004) symptoms on guideline-directed medical therapy (GDMT). (Level of Evidence: A for NYHA class III/IV; Level of Evidence: B for NYHA class II)

Class IIa

- 1. CRT can be useful for patients who have LVEF less than or equal to 35%, sinus rhythm, LBBB with a QRS duration 120 to 149 ms, and NYHA class II, III, or ambulatory IV symptoms on GDMT (Abraham et al., 2002; Bristow et al., 2004; Cleland et al., 2005; Moss et al., 2009; Tang et al., 2010; Linde et al., 2008). (Level of Evidence: B)
- CRT can be useful for patients who have LVEF less than or equal to 35%, sinus rhythm, a non-LBBB pattern with a QRS duration greater than or equal to 150 ms, and NYHA class III/ambulatory class IV symptoms on GDMT (Abraham et al., 2002; Bristow et al., 2004; Cleland et al., 2005; Tang et al., 2010). (Level of Evidence: A)
- 3. CRT can be useful in patients with atrial fibrillation and LVEF less than or equal to 35% on GDMT if a) the patient requires ventricular pacing or otherwise meets CRT criteria and b) AV nodal ablation or pharmacologic rate control will allow near 100% ventricular pacing with CRT (Brignole et al., 2005; Brignole et al., 2011; Doshi et al., 2005; Gasparini et al., 2006; Wilton et al., 2011; Upadhyay et al., 2008). (Level of Evidence: B)
- 4. CRT can be useful for patients on GDMT who have LVEF less than or equal to 35% and are undergoing new or replacement device placement with anticipated requirement for significant (>40%) ventricular pacing (Doshi et al., 2005; Wilkoff et al., 2002; Adelstein et al., 2011; Vatankulu et al., 2009). (Level of Evidence: C)

Class IIb

- CRT may be considered for patients who have LVEF less than or equal to 30%, ischemic etiology of heart failure, sinus rhythm, LBBB with a QRS duration of greater than or equal to 150 ms, and NYHA class I symptoms on GDMT (Moss et al., 2009; Tang et al., 2010). (Level of Evidence: C)
- 2. CRT may be considered for patients who have LVEF less than or equal to 35%, sinus rhythm, a non-LBBB pattern with QRS duration 120 to 149 ms, and NYHA class III/ambulatory class IV on GDMT (Tang et al., 2010; Rickard et al., 2011). (Level of Evidence: B)
- 3. CRT may be considered for patients who have LVEF less than or equal to 35%, sinus rhythm, a non-LBBB pattern with a QRS duration greater than or equal to 150 ms, and NYHA class II symptoms on GDMT (Moss et al., 2009; Tang et al., 2010). (Level of Evidence: B)

- 1. CRT is not recommended for patients with NYHA class I or II symptoms and non-LBBB pattern with QRS duration less than 150 ms (Moss et al., 2009; Tang et al., 2010; Rickard et al., 2011). (Level of Evidence: B)
- 2. CRT is not indicated for patients whose comorbidities and/or frailty limit survival with good functional capacity to less than 1 year (Goldstein et al., 2004). (Level of Evidence: C)

Recommendations for Pacing in Patients with Hypertrophic Cardiomyopathy (HCM)

Class I

1. Permanent pacing is indicated for SND or AV block in patients with HCM as described previously (see Section 2.1.1, "Sinus Node Dysfunction," and Section 2.1.2, "Acquired Atrioventricular Block in Adults" in the original guideline document). (Level of Evidence: C)

Class IIa

1. Permanent pacing may be considered in medically refractory symptomatic patients with HCM and significant resting or provoked LV outflow tract obstruction. (Level of Evidence: A) As for Class I indications, when risk factors for sudden cardiac death (SCD) are present, consider a DDD (dual-chamber pacemaker that senses/paces in the atrium/ventricle and is inhibited/triggered by intrinsic rhythm) implantable cardioverter-defibrillator (ICD) (see Section 3, "Indications for Implantable Cardioverter-Defibrillator Therapy," in the original guideline document) (Fananapazir et al., 1994; Nishimura et al., 1997; Kappenberger et al., 1997; Maron et al., 1999; Nishimura et al., "Effect," 1996; Nishimura et al., "Dual-chamber," 1996).

Class III

- 1. Permanent pacemaker implantation is not indicated for patients who are asymptomatic or whose symptoms are medically controlled. (Level of Evidence: C)
- 2. Permanent pacemaker implantation is not indicated for symptomatic patients without evidence of LV outflow tract obstruction. (Level of Evidence: C)

Recommendations for Permanent Pacing in Children, Adolescents, and Patients with Congenital Heart Disease

Class I

- 1. Permanent pacemaker implantation is indicated for advanced second- or third-degree AV block associated with symptomatic bradycardia, ventricular dysfunction, or low cardiac output. (Level of Evidence: C)
- 2. Permanent pacemaker implantation is indicated for SND with correlation of symptoms during age-inappropriate bradycardia. The definition of bradycardia varies with the patient's age and expected heart rate (Kay, Estioko, & Wiener, 1982; Ector, Rolies, & De Geest, 1983; Beder et al., 1983; Kelly et al., 2001). (Level of Evidence: B)
- 3. Permanent pacemaker implantation is indicated for postoperative advanced second- or third-degree AV block that is not expected to resolve or that persists at least 7 days after cardiac surgery (Strasberg et al., 1981; Lillehei et al., 1963). (Level of Evidence: B)
- 4. Permanent pacemaker implantation is indicated for congenital third-degree AV block with a wide QRS escape rhythm, complex ventricular ectopy, or ventricular dysfunction (Michaelsson, Jonzon, & Riesenfield, 1995; Moak et al., 2001; Villain et al., 2006). (Level of Evidence: B)
- 5. Permanent pacemaker implantation is indicated for congenital third-degree AV block in the infant with a ventricular rate less than 55 bpm or with congenital heart disease and a ventricular rate less than 70 bpm (Pinsky et al., 1982; Jaeggi et al., 2002). (Level of Evidence: C)

Class IIa

- 1. Permanent pacemaker implantation is reasonable for patients with congenital heart disease and sinus bradycardia for the prevention of recurrent episodes of intra-atrial reentrant tachycardia; SND may be intrinsic or secondary to antiarrhythmic treatment (Silka et al., 1990; Stephenson et al., 2003; Pfammatter et al., 1995). (Level of Evidence: C)
- 2. Permanent pacemaker implantation is reasonable for congenital third-degree AV block beyond the first year of life with an average heart rate less than 50 bpm, abrupt pauses in ventricular rate that are 2 or 3 times the basic cycle length, or associated with symptoms due to chronotropic incompetence (Dewey, Capeless, & Levy, 1987; Sholler & Walsh, 1989). (Level of Evidence: B)
- 3. Permanent pacemaker implantation is reasonable for sinus bradycardia with complex congenital heart disease with a resting heart rate less than 40 bpm or pauses in ventricular rate longer than 3 seconds. (Level of Evidence: C)
- 4. Permanent pacemaker implantation is reasonable for patients with congenital heart disease and impaired hemodynamics due to sinus bradycardia or loss of AV synchrony (Cohen et al., 2001). (Level of Evidence: C)

5. Permanent pacemaker implantation is reasonable for unexplained syncope in the patient with prior congenital heart surgery complicated by transient complete heart block with residual fascicular block after a careful evaluation to exclude other causes of syncope (Villain et al., 2006; Banks, Jenson, & Kugler, 2001; Gross et al., 2006; Villain et al., 2003). (Level of Evidence: B)

Class IIb

- 1. Permanent pacemaker implantation may be considered for transient postoperative third-degree AV block that reverts to sinus rhythm with residual bifascicular block (Krongrad, 1978). (Level of Evidence: C)
- 2. Permanent pacemaker implantation may be considered for congenital third-degree AV block in asymptomatic children or adolescents with an acceptable rate, a narrow QRS complex, and normal ventricular function (Sholler & Walsh, 1989; Michaelsson, Jonzon, & Riesenfield, 1995). (Level of Evidence: B)
- 3. Permanent pacemaker implantation may be considered for asymptomatic sinus bradycardia after biventricular repair of congenital heart disease with a resting heart rate less than 40 bpm or pauses in ventricular rate longer than 3 seconds. (Level of Evidence: C)

Class III

- 1. Permanent pacemaker implantation is not indicated for transient postoperative AV block with return of normal AV conduction in the otherwise asymptomatic patient (Weindling et al., 1998; Krongrad, 1978). (Level of Evidence: B)
- 2. Permanent pacemaker implantation is not indicated for asymptomatic bifascicular block with or without first-degree AV block after surgery for congenital heart disease in the absence of prior transient complete AV block. (Level of Evidence: C)
- 3. Permanent pacemaker implantation is not indicated for asymptomatic type I second-degree AV block. (Level of Evidence: C)
- 4. Permanent pacemaker implantation is not indicated for asymptomatic sinus bradycardia with the longest relative risk interval less than 3 seconds and a minimum heart rate more than 40 bpm. (Level of Evidence: C)

Indications for ICD Therapy

Recommendations for ICDs

Class I

- ICD therapy is indicated in patients who are survivors of cardiac arrest due to ventricular fibrillation (VF) or hemodynamically unstable sustained VT after evaluation to define the cause of the event and to exclude any completely reversible causes (European Heart Rhythm Association et al., 2006; "A comparison of antiarrhythmic-drug therapy," 1997; Wever et al., 1995; Siebels & Kuck, 1994; Connolly et al., "Canadian," 2000; Kuck et al., 2000; Connolly et al., "Meta-analysis," 2000). (Level of Evidence: A)
- ICD therapy is indicated in patients with structural heart disease and spontaneous sustained VT, whether hemodynamically stable or unstable (European Heart Rhythm Association et al., 2006; "A comparison of antiarrhythmic-drug therapy," 1997; Wever et al., 1995; Siebels & Kuck, 1994; Connolly et al., "Canadian," 2000; Kuck et al., 2000; Connolly et al., "Meta-analysis," 2000). (Level of Evidence: B)
- 3. ICD therapy is indicated in patients with syncope of undetermined origin with clinically relevant, hemodynamically significant sustained VT or VF induced at electrophysiological study (European Heart Rhythm Association et al., 2006; Connolly et al., "Canadian," 2000). (Level of Evidence: B)
- 4. ICD therapy is indicated in patients with LVEF less than 35% due to prior MI who are at least 40 days post-MI and are in NYHA functional Class II or III (European Heart Rhythm Association et al., 2006; Bardy et al., 2005). (Level of Evidence: A)
- 5. ICD therapy is indicated in patients with nonischemic dilated cardiomyopathy (DCM) who have an LVEF less than or equal to 35% and who are in NYHA functional Class II or III (European Heart Rhythm Association et al., 2006; Bardy et al., 2005; Kadish et al., 2004; Desai et al., 2004). (Level of Evidence: B)
- 6. ICD therapy is indicated in patients with LV dysfunction due to prior MI who are at least 40 days post-MI, have an LVEF less than 30%, and are in NYHA functional Class I (European Heart Rhythm Association et al., 2006; Moss et al., 2002). (Level of Evidence: A)
- 7. ICD therapy is indicated in patients with nonsustained VT due to prior myocardial infarction (MI), LVEF less than 40%, and inducible VF or sustained VT at electrophysiological study (European Heart Rhythm Association et al., 2006; Moss et al., 1996; Buxton et al., 1999). (Level of Evidence: B)

Class IIa

- 1. ICD implantation is reasonable for patients with unexplained syncope, significant LV dysfunction, and nonischemic DCM. (Level of Evidence: C)
- 2. ICD implantation is reasonable for patients with sustained VT and normal or near-normal ventricular function. (Level of Evidence: C)

- 3. ICD implantation is reasonable for patients with HCM who have 1 or more major risk factors for SCD (see Section 3.2.4, "Hypertrophic Cardiomyopathy," in the original guideline document for definition of major risk factors). (Level of Evidence: C)
- 4. ICD implantation is reasonable for the prevention of SCD in patients with ARVD/C who have 1 or more risk factors for SCD. (Level of Evidence: C)
- 5. ICD implantation is reasonable to reduce SCD in patients with long-QT syndrome who are experiencing syncope and/or VT while receiving beta blockers (Zareba et al., 2003; Viskin, 2003; Goel et al., 2004; Monnig et al., 2005; Goldenberg et al., 2006; Hobbs et al., 2006). (Level of Evidence: B)
- 6. ICD implantation is reasonable for nonhospitalized patients awaiting transplantation. (Level of Evidence: C)
- 7. ICD implantation is reasonable for patients with Brugada syndrome who have had syncope. (Level of Evidence: C)
- 8. ICD implantation is reasonable for patients with Brugada syndrome who have documented VT that has not resulted in cardiac arrest. (Level of Evidence: C)
- 9. ICD implantation is reasonable for patients with catecholaminergic polymorphic VT who have syncope and/or documented sustained VT while receiving beta blockers. (Level of Evidence: C)
- 10. ICD implantation is reasonable for patients with cardiac sarcoidosis, giant cell myocarditis, or Chagas disease. (Level of Evidence: C)

Class IIb

- 1. ICD therapy may be considered in patients with nonischemic heart disease who have an LVEF of less than or equal to 35% and who are in NYHA functional Class I. (Level of Evidence: C)
- 2. ICD therapy may be considered for patients with long-QT syndrome and risk factors for SCD (European Heart Rhythm Association et al., 2006; Zareba et al., 2003; Viskin, 2003; Goel et al., 2004; Monnig et al., 2005; Goldenberg et al., 2006; Hobbs et al., 2006). (Level of Evidence: B)
- 3. ICD therapy may be considered in patients with syncope and advanced structural heart disease in whom thorough invasive and noninvasive investigations have failed to define a cause. (Level of Evidence: C)
- 4. ICD therapy may be considered in patients with a familial cardiomyopathy associated with sudden death. (Level of Evidence: C)
- 5. ICD therapy may be considered in patients with LV noncompaction. (Level of Evidence: C)

Class III

- 1. ICD therapy is not indicated for patients who do not have a reasonable expectation of survival with an acceptable functional status for at least 1 year, even if they meet ICD implantation criteria specified in the Class I, IIa, and IIb recommendations above. (Level of Evidence: C)
- 2. ICD therapy is not indicated for patients with incessant VT or VF. (Level of Evidence: C)
- 3. ICD therapy is not indicated in patients with significant psychiatric illnesses that may be aggravated by device implantation or that may preclude systematic follow-up. (Level of Evidence: C)
- 4. ICD therapy is not indicated for NYHA Class IV patients with drug-refractory congestive heart failure who are not candidates for cardiac transplantation or CRT-D. (Level of Evidence: C)
- 5. ICD therapy is not indicated for syncope of undetermined cause in a patient without inducible ventricular tachyarrhythmias and without structural heart disease. (Level of Evidence: C)
- ICD therapy is not indicated when VF or VT is amenable to surgical or catheter ablation (e.g., atrial arrhythmias associated with the Wolff-Parkinson-White syndrome, RV or LV outflow tract VT, idiopathic VT, or fascicular VT in the absence of structural heart disease). (Level of Evidence: C)
- 7. ICD therapy is not indicated for patients with ventricular tachyarrhythmias due to a completely reversible disorder in the absence of structural heart disease (e.g., electrolyte imbalance, drugs, or trauma) (European Heart Rhythm Association et al., 2006). (Level of Evidence: B)

Recommendations for ICDs in Pediatric Patients and Patients with Congenital Heart Disease

Class I

- 1. ICD implantation is indicated in the survivor of cardiac arrest after evaluation to define the cause of the event and to exclude any reversible causes (Silka et al., 1993; Hamilton et al., 1996; Alexander et al., 2004; Choi, Porter, & Ackerman, 2004). (Level of Evidence: B)
- 2. ICD implantation is indicated for patients with symptomatic sustained VT in association with congenital heart disease who have undergone hemodynamic and electrophysiological evaluation. Catheter ablation or surgical repair may offer possible alternatives in carefully selected patients (Karamlou et al., 2006). (Level of Evidence: C)

1. ICD implantation is reasonable for patients with congenital heart disease with recurrent syncope of undetermined origin in the presence of either ventricular dysfunction or inducible ventricular arrhythmias at electrophysiological study (Mushlin et al., 1998; Khairy et al., 2004). (Level of Evidence: B)

Class IIb

 ICD implantation may be considered for patients with recurrent syncope associated with complex congenital heart disease and advanced systemic ventricular dysfunction when thorough invasive and noninvasive investigations have failed to define a cause (Kammeraad et al., 2004; Dubin et al., 2003). (Level of Evidence: C)

Class III

 All Class III recommendations found in Section 3, "Indications for Implantable Cardioverter-Defibrillator Therapy," in the original guideline document apply to pediatric patients and patients with congenital heart disease, and ICD implantation is not indicated in these patient populations. (Level of Evidence: C)

Definitions:

Applying Classification of Recommendations and Level of Evidence

| | | Size of Treatment Effect | | | | | |
|--|--|--|--|--|--|---|---------------------------------|
| | | CLASS I Benefit >>> Risk Procedure/Treatment | CLASS IIa Benefit >> Risk Additional studies with focused objectives needed | CLASS IIb Benefit ≥ Risk Additional studies with broad objectives needed; additional | CLASS III No Benefit or CLASS III Harm | | |
| | | | | | Procedure/Test | Treatment | |
| | | SHOULD be performed/ administered | ITIS REASONABLE to perform procedure/administer treatment | registry data would be helpful Procedure/Treatment MAY BE CONSIDERED | COR III: No Benefit | Not helpful | No proven benefit |
| | | | | | COR III: Harm | Excess Cost without Benefit or Harmful | Harmful to Patients |
| Estimate of Certainty (Precision) of Treatment Effect | LEVEL A Multiple populations evaluated* Data derived frommultiple randomized clinical trials or meta-analyses | Recommendation that procedure or treatment is useful/effective Sufficient evidence fromnultiple randonized trials or meta-analyses | Recommendation in favor oftreatment or procedure being useful/effective Some conflicting evidence frommultiple randomized trials or meta-analyses | Recommendation's usefulness/efficacy less well established Greater conflicting evidence frommultiple randomized trials or meta-analyses | Recommendation that procedur or treatment is not useful/effecti and may be harmful Sufficient evidence frommultip randomized trials or meta-analy | | seful/effective |
| | LEVEL B Linited populations evaluated* Data derived from single randomized clinical trials or nonrandomized studies | Recommendation that procedure or treatment is useful/effective Evidence from single randomized trial or nonrandomized studies | Recommendation in favor oftreatment or procedure being useful/effective Some conflicting evidence fromsingle randomized trial or nonrandomized studies | Recommendation's usefulness/efficacy less well established Greater conflicting evidence fromsingle randomized trial or nonrandomized studies | Recommendation that procedure or treatment is not useful/effection and may be harmful Evidence fromsingle randonized studies | | seful/effective e randomized |
| | LEVEL C Very limited populations evaluated* Only consensus opinion of experts, case studies or standard of care | Recommendation that procedure or treatment is useful/effective Only expert opinion, case studies, or standard of care | Recommendation in favor oftreatment or procedure being useful/effective Only diverging expert opinion, case studies, or standard of care | Recommendation's usefulness/efficacy less well established Only diverging expert opinion, case studies, or standard of care | • | Recommendation the or treatment is not u and may be harmful Only expert opinior or standard of care | seful/effective |

A recommendation with Level of Evidence B or C does not imply that the recommendation is weak. Many important clinical questions addressed in the guidelines do not lend themselves to clinical trials. Although randomized trials are unavailable, there may be a very clear clinical consensus that a particular test or therapy is useful or effective.

*Data available from clinical trials or registries about the usefulness/efficacy in different subpopulations, such as gender, age, history of diabetes, history of prior myocardial infarction, history of heart failure, and prior aspirin use.

Clinical Algorithm(s)

The following algorithms are provided in the original guideline document:

- Selection of Pacemaker Systems for Patients with Atrioventricular Block
- Selection of Pacemaker Systems for Patients with Sinus Node Dysfunction
- 2012 Indications for Cardiac Resynchronization Therapy (CRT) (Appendix 6)

Scope

Disease/Condition(s)

Cardiac rhythm abnormalities requiring cardiac pacemakers or implantable cardioverter-defibrillator (ICD) devices, including:

- Sinus node dysfunction
- Acquired atrioventricular (AV) block
- Chronic bifascicular block
- AV block following acute myocardial infarction
- Hypersensitive carotid sinus syndrome
- Neurocardiogenic syncope
- Bradycardia or syncope following cardiac transplantation
- · Arrhythmias associated with neuromuscular diseases, sleep apnea syndrome or cardiac sarcoidosis
- Long-QT syndrome
- Tachycardias
- Atrial fibrillation
- Severe systolic heart failure
- Hypertrophic cardiomyopathy
- Congenital heart disease

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Management

Prevention

Treatment

Clinical Specialty

Cardiology

Geriatrics

Internal Medicine

Pediatrics

Thoracic Surgery

Intended Users

Physicians

Guideline Objective(s)

- To revise the existing guideline recommendations that are affected by evolving data or opinion
- To update the 2008 recommendations for device-based therapy of cardiac rhythm abnormalities

Target Population

Children, adolescents, and adults in need of permanent cardiac pacemaker and/or implantable cardioverter-defibrillator (ICD) insertion to restore

Interventions and Practices Considered

- 1. Permanent cardiac pacemaker insertion
- 2. Implantable cardioverter-defibrillator (ICD) therapy

Note: The writing committee considered the advisability of extending the scope of these guidelines to include recommendations for follow-up and device replacement but deferred this decision given other published statements and guidelines on this topic. These are addressed in the original guideline document as a matter of information; however, no endorsement is implied.

Major Outcomes Considered

Subjective and objective symptom improvement

Quality of life

Functional status

New York Heart Association functional classification

Exercise capacity

Patient adherence

Heart failure end points

Atrial fibrillation end points

Stroke or thromboembolism end points

Rates of inappropriate implantable cardioverter-defibrillator detections and therapies

Sudden cardiac death

All-cause mortality

Methodology

Methods Used to Collect/Select the Evidence

Hand-searches of Published Literature (Primary Sources)

Hand-searches of Published Literature (Secondary Sources)

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

2008 Guideline

An extensive literature survey was conducted that led to the incorporation of 527 references. Searches were limited to studies, reviews, and other evidence conducted in human subjects and published in English. Key search words included but were not limited to antiarrhythmic, antibradycardia, atrial fibrillation, bradyarrhythmia, cardiac, cardiac resynchronization therapy (CRT), defibrillator, device therapy, devices, dual chamber, heart, heart failure, implantable cardioverter-defibrillator (ICD), implantable defibrillator, device implantation, long-QT syndrome, medical therapy, pacemaker, pacing, quality-of-life, resynchronization, rhythm, sinus node dysfunction, sleep apnea, sudden cardiac death, syncope, tachyarrhythmia, terminal care, and transplantation. Additionally, the committee reviewed documents related to the subject matter previously published by the American College of Cardiology (ACC), American Heart Association (AHA), and Heart Rhythm Society (HRS). Searches were conducted from approximately 2005 through early 2008.

2012 Focused Update

The 2012 focused update is not intended to be based on a complete literature review from the date of the previous guideline publication but rather to include pivotal new evidence that may affect changes to current recommendations.

For the 2012 focused update, late-breaking clinical trials presented at the annual scientific meetings of the ACC, AHA, and HRS, and European Society of Cardiology (2008 through 2010), as well as other selected data reported through February 2012, were reviewed by the guideline writing group along with the Task Force and other experts to identify trials and other key data that might affect guideline recommendations. Studies relevant to the management of patients treated with device-based therapy (DBT) for cardiac rhythm abnormalities were identified and reviewed. On the basis of these data, the writing group determined that updates to the 2008 guideline were necessary for cardiac resynchronization therapy (CRT) and device follow-up. The writing group also thoroughly reviewed other sections from the 2008 DBT guideline on hypertrophic cardiomyopathy, arrhythmogenic right ventricular dysplasia/cardiomyopathy, genetic arrhythmia syndromes, congenital heart disease, primary electrical disease, and terminal care; and determined that although some new information may be available, the recommendations remain current.

An extensive literature survey was conducted that led to the incorporation of 595 references. Searches were limited to studies, reviews, and other evidence conducted in human subjects and published in English. Key search words included but were not limited to antiarrhythmic, antibradycardia, atrial fibrillation, bradyarrhythmia, cardiac, CRT, defibrillator, device therapy, devices, dual chamber, heart, heart failure, ICD, implantable defibrillator, device implantation, long-QT syndrome, medical therapy, pacemaker, pacing, quality-of-life, resynchronization, rhythm, sinus node dysfunction, sleep apnea, sudden cardiac death, syncope, tachyarrhythmia, terminal care, and transplantation. Additionally, the committee reviewed documents related to the subject matter previously published by the ACC, AHA, and HRS. References selected and published in this document are representative and not all-inclusive.

Number of Source Documents

2008 Guideline

The literature survey led to the incorporation of 527 references.

2012 Update

The literature survey led to the incorporation of 595 references.

Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Applying Classification of Recommendations and Level of Evidence

| | | Size of Treatment Effect | | | | | |
|--|--|--|--|---|--|--|---------------------------------|
| | | CLASS I Benefit >>> Risk Procedure/Treatment SHOULD be performed/ administered | CLASS IIa Benefit >> Risk Additional studies with focused objectives needed IT IS REASONABLE to perform procedure/administer treatment | CLASS IIb Benefit ≥ Risk Additional studies with broad objectives needed; additional registry data would be helpful Procedure/Treatment MAY BE CONSIDERED | CLASS III No Benefit or CLASS III Harm | | |
| | | | | | | Procedure/Test | Treatment |
| | | | | | COR III: No Benefit | Not helpful | No proven benefit |
| | | | | | COR III: Harm | Excess Cost without Benefit or Harmful | Hamful to Patients |
| Estimate of Certainty (Precision) of Treatment Effect | LEVEL A Multiple populations evaluated* Data derived frommultiple randomized clinical trials or meta-analyses | Recommendation that procedure or treatment is useful/effective Sufficient evidence frommultiple randomized trials or meta-analyses | Recommendation in favor oftreatment or procedure being useful/effective Some conflicting evidence frommultiple randomized trials or meta-analyses | Recommendation's usefulness/efficacy less well established Greater conflicting evidence frommultiple randomized trials or meta-analyses | Recommendation that procedure or treatment is not useful/effective and may be harmful Sufficient evidence frommultiple randomized trials or meta-analyses | | |
| | LEVEL B Limited populations evaluated* Data derived from single randomized clinical trials or nonrandomized studies | Recommendation that procedure or treatment is useful/effective Evidence from single randomized trial or nonrandomized studies | Recommendation in favor of treatment or procedure being useful/effective Some conflicting evidence from single randomized trial or nonrandomized studies | Recommendation's usefulness/efficacy less well established Greater conflicting evidence fromsingle randomized trial or nonrandomized studies | Recommendation that procedure or treatment is not useful/effectiv and may be harmful Evidence from single randonized trial or nonrandonized studies | | seful/effective e randomized |
| | LEVELC | Reconmendation | Recommendation in favor | Recommendation's | | Recommendation that | at procedure |

| experts, case studies or studies, or standard standard of care of care | Very limited populations evaluated* Only consensus opinion of experts, case studies or standard of care | * | oftreatment or procedus being useful/effective Only diverging expert opinion, case studies, or standard of care | f Treatment Frequess/efficacy less well established Only diverging expert opinion, case studies, or standard of care | or treatment is not useful/effective and may be harmful Only expert opinion, case studies, or standard of care |
|--|--|---|--|---|---|
|--|--|---|--|---|---|

A recommendation with Level of Evidence B or C does not imply that the recommendation is weak. Many important clinical questions addressed in the guidelines do not lend themselves to clinical trials. Although randomized trials are unavailable, there may be a very clear clinical consensus that a particular test or therapy is useful or effective.

*Data available from clinical trials or registries about the usefulness/efficacy in different subpopulations, such as gender, age, history of diabetes, history of prior myocardial infarction, history of heart failure, and prior aspirin use.

Methods Used to Analyze the Evidence

Review of Published Meta-Analyses

Systematic Review with Evidence Tables

Description of the Methods Used to Analyze the Evidence

2008 Guideline

Writing committees were specifically charged to perform a formal literature review, weigh the strength of evidence for or against a particular treatment or procedure, and include estimates of expected health outcomes where data exist. The committee reviewed and ranked evidence supporting current recommendations, with the weight of evidence ranked as Level A if the data were derived from multiple randomized clinical trials that involved a large number of individuals. The committee ranked available evidence as Level B when data were derived either from a limited number of trials that involved a comparatively small number of patients or from well-designed data analyses of nonrandomized studies or observational data registries. Evidence was ranked as Level C when the consensus of experts was the primary source of the recommendation. See the "Rating Scheme for the Strength of the Evidence" field.

2012 Focused Update

Writing committees are specifically charged to perform a literature review, weigh the strength of evidence for or against a particular treatment or procedure, and include estimates of expected health outcomes where data exist.

In analyzing the data and developing recommendations and supporting text, the focused update writing group uses evidence-based methodologies developed by the Task Force. The Class of Recommendation (COR) is an estimate of the size of the treatment effect, with consideration given to risks versus benefits, as well as evidence and/or agreement that a given treatment or procedure is or is not useful/effective and in some situations may cause harm. The Level of Evidence (LOE) is an estimate of the certainty or precision of the treatment effect. The writing group reviews and ranks evidence supporting each recommendation, with the weight of evidence ranked as LOE A, B, or C, according to specific definitions (see the "Rating Scheme for the Strength of the Evidence" field). Studies are identified as observational, retrospective, prospective, or randomized, as appropriate. For certain conditions for which inadequate data are available, recommendations are based on expert consensus and clinical experience and are ranked as LOE C. When recommendations at LOE C are supported by historical clinical data, appropriate references (including clinical reviews) are cited if available. For issues for which sparse data are available, a survey of current practice among the clinician members of the writing group is the basis for LOE C recommendations, and no references are cited. The schema for COR and LOE is summarized in the "Rating Scheme for the Strength of the Evidence" field. A new addition to this methodology for the 2012 focused update is separation of the Class III recommendations to delineate whether the recommendation is determined to be of "no benefit" or is associated with "harm" to the patient. (This version of the COR/LOE table was used for development of the 2012 Focused Update.)

Methods Used to Formulate the Recommendations

Expert Consensus

Description of Methods Used to Formulate the Recommendations

2008 Guideline

Experts in the subject under consideration are selected from the American College of Cardiology (ACC) and the American Heart Association (AHA) to examine subject-specific data and write guidelines. The process includes additional representatives from other medical practitioner specialty groups when appropriate. Writing committees are specifically charged to perform a formal literature review, weigh the strength of evidence for or against a particular treatment or procedure, and include estimates of expected health outcomes where data exist. Patient-specific modifiers, comorbidities, and issues of patient preference that may influence the choice of particular tests or therapies are considered as well as frequency of follow-up and cost-effectiveness.

In preparing this revision, the committee was guided by the following principles:

- 1. Changes in recommendations and levels of evidence were made either because of new randomized trials or because of the accumulation of new clinical evidence and the development of clinical consensus.
- 2. The committee was cognizant of the health care, logistic, and financial implications of recent trials and factored in these considerations to arrive at the classification of certain recommendations.
- 3. For recommendations taken from other guidelines, wording changes were made to render some of the original recommendations more precise.
- 4. The committee would like to reemphasize that the recommendations in this guideline apply to most patients but may require modification because of existing situations that only the primary treating physician can evaluate properly.
- 5. All of the listed recommendations for implantation of a device presume the absence of inciting causes that may be eliminated without detriment to the patient (e.g., nonessential drug therapy).
- 6. The committee endeavored to maintain consistency of recommendations in this and other previously published guidelines. In the section on atrioventricular (AV) block associated with acute myocardial infarction (AMI), the recommendations follow closely those in the "ACC/AHA Guidelines for the Management of Patients with ST-Elevation Myocardial Infarction". However, because of the rapid evolution of pacemaker/implantable cardioverter-defibrillator (ICD) science, it has not always been possible to maintain consistency with other published guidelines.

2012 Focused Update

Experts in the subject under consideration have been selected from both organizations to examine subject-specific data and write guidelines. The process includes additional representatives from other medical practitioner and specialty groups when appropriate. Writing committees are specifically charged to perform a literature review, weigh the strength of evidence for or against a particular treatment or procedure, and include estimates of expected health outcomes where data exist. Patient-specific modifiers, comorbidities, and issues of patient preference that may influence the choice of particular tests or therapies are considered, as well as frequency of follow-up and cost-effectiveness. When available, information from studies on cost will be considered; however, review of data on efficacy and clinical outcomes will constitute the primary basis for preparing recommendations in these guidelines.

In an effort to respond promptly to new evidence, the Task Force has created a "focused update" process to revise the existing guideline recommendations that are affected by evolving data or opinion. New evidence is reviewed in an ongoing fashion to more efficiently respond to important science and treatment trends that could have a major impact on patient outcomes and quality of care.

Writing committees are charged with the task of performing an assessment of the evidence and acting as an independent group of authors to develop, update, or revise written recommendations for clinical practice. Experts in the subject under consideration have been selected from both organizations to examine subject-specific data and write guidelines. The process includes additional representatives from other medical practitioner and specialty groups when appropriate. Writing committees are specifically charged to perform a literature review, weigh the strength of evidence for or against a particular treatment or procedure, and include estimates of expected health outcomes where data exist. Patient-specific modifiers, comorbidities, and issues of patient preference that may influence the choice of particular tests or therapies are considered, as well as frequency of follow-up and cost-effectiveness. When available, information from studies on cost will be considered; however, review of data on efficacy and clinical outcomes will constitute the primary basis for preparing recommendations in these guidelines.

Because the ACCF/AHA practice guidelines address patient populations (and healthcare providers) residing in North America, drugs that are not currently available in North America are discussed in the text without a specific class of recommendation. For studies performed in large numbers of subjects outside North America, each writing group reviews the potential impact of different practice patterns and patient populations on the treatment effect and relevance to the ACCF/AHA target population to determine whether the findings should inform a specific recommendation.

In preparing this revision, the committee was guided by the following principles:

1. Changes in recommendations and levels of evidence were made either because of new randomized trials or because of the accumulation of new clinical evidence and the development of clinical consensus.

- 2. The committee was cognizant of the health care, logistic, and financial implications of recent trials and factored in these considerations to arrive at the classification of certain recommendations.
- 3. For recommendations taken from other guidelines, wording changes were made to render some of the original recommendations more precise.
- 4. The committee would like to reemphasize that the recommendations in this guideline apply to most patients but may require modification because of existing situations that only the primary treating physician can evaluate properly.
- 5. All of the listed recommendations for implantation of a device presume the absence of inciting causes that may be eliminated without detriment to the patient (e.g., nonessential drug therapy).
- 6. The committee endeavored to maintain consistency of recommendations in this and other previously published guidelines. In the section on AV block associated with AMI, the recommendations follow closely those in the "ACC/AHA Guidelines for the Management of Patients with ST-Elevation Myocardial Infarction." However, because of the rapid evolution of pacemaker/ICD science, it has not always been possible to maintain consistency with other published guidelines.

Rating Scheme for the Strength of the Recommendations

See the "Rating Scheme for the Strength of the Evidence" field above.

Cost Analysis

Optimizing Pacemaker Technology and Cost

An analysis of the Mode Selection Trial (MOST) found that the cost-effectiveness of dual-chamber pacemaker implantation compared with ventricular pacemaker implantation was approximately \$53,000 per quality-adjusted year of life gained over 4 years of follow-up. Extended over the expected lifetime of a typical patient, the calculated cost-effectiveness of dual-chamber pacing improved to \$6800 per quality-adjusted year of life gained.

It has been estimated that 16% to 24% of pacemaker implantations are for replacement of generators; of those, 76% are replaced because their batteries have reached their elective replacement time. Hardware and software (i.e., programming) features of pacemaker systems that prolong useful battery longevity may improve the cost-effectiveness of pacing. Leads with steroid elution and/or high pacing impedance allow for less current drain. Optimal programming of output voltages, pulse widths, and atrioventricular (AV) delays can markedly decrease battery drain; one study showed that expert programming of pacemaker generators can have a major impact on longevity, prolonging it by an average of 4.2 years compared with nominal settings. Generators that automatically determine whether a pacing impulse results in capture allow for pacing outputs closer to threshold values than conventional generators. Although these and other features arguably should prolong generator life, there are other constraints on the useful life of a pacemaker generator, including battery drain not directly related to pulse generation and the limited life expectancy of many pacemaker recipients; rigorous studies supporting the overall cost-effectiveness of these advanced pacing features are lacking.

Cost-Effectiveness of Implantable Cardioverter-Defibrillator (ICD) Therapy

Long-term follow-up studies have consistently demonstrated that cumulative medical costs are increased substantially among patients receiving an ICD. Several studies have attempted to weigh whether these added costs are worthwhile in light of the potential for improved survival among patients receiving ICD therapy. These studies calculate a cost-effectiveness ratio that is defined as the difference in the total cost of patients receiving an ICD and patients receiving alternative therapy, divided by the additional life-years of survival provided by an ICD compared with alternative therapy. A benchmark for comparison is provided by renal dialysis, which costs approximately \$50,000 to add 1 life-year of survival. Cost-effectiveness, like other outcome measures in clinical research studies, must be interpreted in light of the characteristics of the study populations and the length of follow-up available.

The early studies of ICD cost-effectiveness were based on mathematical models and relied on nonrandomized studies to estimate clinical efficacy and cost. These studies found cost-effectiveness ratios of \$17,000, \$18,100, and \$29,200 per year of life saved. Another model incorporated costs of nonthoracotomy ICDs and efficacy estimates based on randomized trials and found ICD cost-effectiveness was between \$27,300 and \$54,000 per life-year gained, which corresponded to risk reductions of 40% and 20%, respectively.

Several randomized clinical trials have measured both cost and clinical outcomes and thus can directly estimate ICD cost-effectiveness. MADIT found a 54% reduction in total mortality and a cost-effectiveness ratio of \$27,000 per life-year added. In contrast, CIDS found a 20% reduction in total mortality and a cost-effectiveness ratio of \$139,000 per life-year added. The cost-effectiveness ratio from the AVID trial was \$66,677 per life-year added. MADIT II found a 32% reduction in total mortality and \$39,200 higher costs among ICD-assigned patients than among those

treated with conventional therapy. The cost-effectiveness ratio in MADIT II was measured as \$235,000 per year of life added at 2 years of follow-up but was projected to be between \$78,600 and \$114,000 per year of life added by 12 years of follow-up. The Sudden Cardiac Death in Heart Failure Trial (SCD-HeFT) reported that total mortality was reduced by 23% and costs increased by \$19,000 over 5 years of follow-up in patients assigned to ICDs compared with patients assigned to placebo. SCD-HeFT estimated the lifetime cost-effectiveness ratio of the ICD strategy was \$38,400 per year of life added. This range of results from randomized studies is primarily due to different estimates of the effectiveness of the ICD in reducing mortality, because all showed similar increases in the cost of care among ICD recipients. When the results of all clinical trials were used in a model that used a consistent framework to project the full gain in life expectancy and lifetime costs in each trial, the cost-effectiveness of the ICD ranged from \$25,300 to \$50,700 per life-year added in the randomized trials in which the ICD reduced mortality. In the Coronary Artery Bypass Graft-Patch (CABG-Patch) trial and Defibrillator in Acute Myocardial Infarction Trial (DINAMIT), however, patients assigned to an ICD had lower survival and higher costs than patients assigned to conventional therapy, and the ICD strategy was not costeffective. The evidence suggests that proper patient selection is necessary for ICD implantation to be cost-effective; when ICD implantation is restricted to appropriately selected patients, it has a cost-effectiveness ratio similar to other accepted cardiovascular therapies and compares well to the standard benchmark of renal dialysis (\$30,000 to \$50,000 per year of life saved). In principle, ICD implantation will be more cost-effective when used for patients at high risk of arrhythmic death and at low risk of other causes of death. Additional risk stratification of patients with a reduced left ventricular ejection fraction (LVEF) may improve patient selection for the ICD and thereby enhance its cost-effectiveness. Costeffectiveness of the ICD would also be improved by lowering the cost of the device itself and further improving its reliability and longevity.

The cost-effectiveness of CRT has not been evaluated extensively. A CRT device that provides pacing but not defibrillation capability (CRT-P device) reduces hospitalization for heart failure patients, and these cost savings partially offset the initial cost of device implantation. CRT-P devices are also effective in improving QOL and may improve survival. The cost-effectiveness of CRT-P devices versus medical therapy appears to be favorable. There are few data on the cost-effectiveness of a CRT device that incorporates both pacing and defibrillation capabilities (CRT-D) compared with CRT-P devices.

Method of Guideline Validation

External Peer Review

Internal Peer Review

Description of Method of Guideline Validation

2008 Guideline

The document was reviewed by 2 official reviewers nominated by each of the American College of Cardiology (ACC), American Heart Association (AHA), and Heart Rhythm Society (HRS) and by 11 additional peer reviewers. Of the total 17 peer reviewers, 10 had no significant relevant relationships with industry. In addition, this document has been reviewed and approved by the governing bodies of the ACC, AHA, and HRS, which include 19 ACC Board of Trustees members (none of whom had any significant relevant relationships with industry), 15 AHA Science Advisory Coordinating Committee members (none of whom had any significant relevant relationships with industry), and 14 HRS Board of Trustees members (6 of whom had no significant relevant relationships with industry). All guideline recommendations underwent a formal, blinded writing committee vote. Writing committee members were required to recuse themselves if they had a significant relevant relationship with industry. The guideline recommendations were unanimously approved by all members of the writing committee who were eligible to vote. The section "Pacing in Children and Adolescents" was reviewed by additional reviewers with special expertise in pediatric electrophysiology.

The guideline document was approved by the ACC Foundation Board of Trustees, the AHA Science Advisory and Coordinating Committee, and the HRS Board of Trustees in February 2008.

2012 Update

The 2012 focused update was reviewed by 2 official reviewers each nominated by the ACC, AHA, and HRS, as well as 1 reviewer each from the American Association for Thoracic Surgery, Heart Failure Society of America, and Society of Thoracic Surgeons, and 21 individual content reviewers. All information on reviewers' relationships with industry and other entities was collected and distributed to the writing group and is published in this document (see Appendix 5 of the original guideline document). The 2012 focused update was approved for publication by the governing bodies of the ACCF, AHA, and HRS and was endorsed by the American Association for Thoracic Surgery, Heart Failure Society of America, and Society of Thoracic Surgeons.

The guideline document was approved by the ACCF Board of Trustees, the AHA Science Advisory and Coordinating Committee, and the HRS

Evidence Supporting the Recommendations

References Supporting the Recommendations

A comparison of antiarrhythmic-drug therapy with implantable defibrillators in patients resuscitated from near-fatal ventricular arrhythmias. The Antiarrhythmics versus Implantable Defibrillators (AVID) Investigators. N Engl J Med. 1997 Nov 27;337(22):1576-83. PubMed

Abraham WT, Fisher WG, Smith AL, Delurgio DB, Leon AR, Loh E, Kocovic DZ, Packer M, Clavell AL, Hayes DL, Ellestad M, Trupp RJ, Underwood J, Pickering F, Truex C, McAtee P, Messenger J. Cardiac resynchronization in chronic heart failure. N Engl J Med. 2002 Jun 13;346(24):1845-53. PubMed

Adelstein E, Schwartzman D, Gorcsan J 3rd, Saba S. Predicting hyperresponse among pacemaker-dependent nonischemic cardiomyopathy patients upgraded to cardiac resynchronization. J Cardiovasc Electrophysiol. 2011 Aug;22(8):905-11. PubMed

Alexander ME, Cecchin F, Walsh EP, Triedman JK, Bevilacqua LM, Berul CI. Implications of implantable cardioverter defibrillator therapy in congenital heart disease and pediatrics. J Cardiovasc Electrophysiol. 2004 Jan;15(1):72-6. PubMed

Ammirati F, Colivicchi F, Santini M. Permanent cardiac pacing versus medical treatment for the prevention of recurrent vasovagal syncope: a multicenter, randomized, controlled trial. Circulation. 2001 Jul 3;104(1):52-7.

Antman EM, Anbe DT, Armstrong PW, Bates ER, Green LA, Hand M, Hochman JS, Krumholz HM, Kushner FG, Lamas GA, Mullany CJ, Ornato JP, Pearle DL, Sloan MA, Smith SC Jr, Alpert JS, Anderson JL, Faxon DP, Fuster V, Gibbons RJ, Gregoratos G, Halperin JL, Hiratzka LF, Hunt SA, Jacobs AK, Ornato JP. ACC/AHA guidelines for the management of patients with ST-elevation myocardial infarction; A report of the Am Coll of Cardiol/Am Heart Assoc Task Force on Practice Guidelines (Committee to Revise the 1999 Guidelines for the Management of patients [trunc]. J Am Coll Cardiol. 2004 Aug 4;44(3):E1-211. PubMed

Banks MA, Jenson J, Kugler JD. Late development of atrioventricular block after congenital heart surgery in Down syndrome. Am J Cardiol. 2001 Jul 1;88(1):A7, 86-9. PubMed

Bardy GH, Lee KL, Mark DB, Poole JE, Packer DL, Boineau R, Domanski M, Troutman C, Anderson J, Johnson G, McNulty SE, Clapp-Channing N, Davidson-Ray LD, Fraulo ES, Fishbein DP, Luceri RM, Ip JH. Amiodarone or an implantable cardioverter-defibrillator for congestive heart failure. N Engl J Med. 2005 Jan 20;352(3):225-37. PubMed

Barold SS, Mugica J. New perspectives in cardiac pacing. Mount Kisco (NY): Futura Publishing, 1991. 23 p.

Barold SS, Wyndham CR, Kappenberger LL, Abinader EG, Griffin JC, Falkoff MD. Implanted atrial pacemakers for paroxysmal atrial flutter. Long-term efficacy. Ann Intern Med. 1987 Aug;107(2):144-9. PubMed

Barold SS. Indications for permanent cardiac pacing in first-degree AV block: class I, II, or III. Pacing Clin Electrophysiol. 1996 May;19(5):747-51. PubMed

Beder SD, Gillette PC, Garson A Jr, Porter CB, McNamara DG. Symptomatic sick sinus syndrome in children and adolescents as the only manifestation of cardiac abnormality or associated with unoperated congenital heart disease. Am J Cardiol. 1983 Apr;51(7):1133-6. PubMed

Brignole M, Botto G, Mont L, Iacopino S, De Marchi G, Oddone D, Luzi M, Tolosana JM, Navazio A, Menozzi C. Cardiac

resynchronization therapy in patients undergoing atrioventricular junction ablation for permanent atrial fibrillation: a randomized trial. Eur Heart J. 2011 Oct;32(19):2420-9. PubMed

Brignole M, Gammage M, Puggioni E, Alboni P, Raviele A, Sutton R, Vardas P, Bongiorni MG, Bergfeldt L, Menozzi C, Musso G, Optimal Pacing SITE (OPSITE) Study Investigators. Comparative assessment of right, left, and biventricular pacing in patients with permanent atrial fibrillation. Eur Heart J. 2005 Apr;26(7):712-22. PubMed

Brignole M, Menozzi C, Gianfranchi L, Oddone D, Lolli G, Bertulla A. Neurally mediated syncope detected by carotid sinus massage and head-up tilt test in sick sinus syndrome. Am J Cardiol. 1991 Oct 15;68(10):1032-6. PubMed

Brignole M, Menozzi C, Lolli G, Bottoni N, Gaggioli G. Long-term outcome of paced and nonpaced patients with severe carotid sinus syndrome. Am J Cardiol. 1992 Apr 15;69(12):1039-43. PubMed

Brignole M, Menozzi C, Moya A, Garcia-Civera R, Mont L, Alvarez M, Errazquin F, Beiras J, Bottoni N, Donateo P, International Study on Syncope of Uncertain Etiology (ISSUE) Investigators. Mechanism of syncope in patients with bundle branch block and negative electrophysiological test. Circulation. 2001 Oct 23;104(17):2045-50. PubMed

Bristow MR, Saxon LA, Boehmer J, Krueger S, Kass DA, De Marco T, Carson P, DiCarlo L, DeMets D, White BG, DeVries DW, Feldman AM. Cardiac-resynchronization therapy with or without an implantable defibrillator in advanced chronic heart failure. N Engl J Med. 2004 May 20;350(21):2140-50. [20 references] PubMed

Buxton AE, Lee KL, Fisher JD, Josephson ME, Prystowsky EN, Hafley G, Multicenter Unsustained Tachycardia Trial Investigators. A randomized study of the prevention of sudden death in patients with coronary artery disease. Multicenter Unsustained Tachycardia Trial Investigators. N Engl J Med. 1999 Dec 16;341(25):1882-90. PubMed

Charles R, Holt S, Kay JM, Epstein EJ, Rees JR. Myocardial ultrastructure and the development of atrioventricular block in Kearns-Sayre syndrome. Circulation. 1981 Jan;63(1):214-9. PubMed

Cheng TO. Atrial pacing: its diagnostic and therapeutic applications. Prog Cardiovasc Dis. 1971 Sep;14(2):230-47. [38 references]

Choi GR, Porter CB, Ackerman MJ. Sudden cardiac death and channelopathies: a review of implantable defibrillator therapy. Pediatr Clin North Am. 2004;51(5):1289-303. PubMed

Chokshi SK, Sarmiento J, Nazari J, Mattioni T, Zheutlin T, Kehoe R. Exercise-provoked distal atrioventricular block. Am J Cardiol. 1990 Jul 1;66(1):114-6. PubMed

Cleland JG, Daubert JC, Erdmann E, Freemantle N, Gras D, Kappenberger L, Tavazzi L, Cardiac Resynchronization-Heart Failure (CARE-HF) Study Investigators. The effect of cardiac resynchronization on morbidity and mortality in heart failure. N Engl J Med. 2005 Apr 14;352(15):1539-49. PubMed

Click RL, Gersh BJ, Sugrue DD, Holmes DR Jr, Wood DL, Osborn MJ, Hammill SC. Role of invasive electrophysiologic testing in patients with symptomatic bundle branch block. Am J Cardiol. 1987 Apr 1;59(8):817-23. PubMed

Cohen MI, Rhodes LA, Wernovsky G, Gaynor JW, Spray TL, Rychik J. Atrial pacing: an alternative treatment for protein-losing enteropathy after the Fontan operation. J Thorac Cardiovasc Surg. 2001 Mar;121(3):582-3. PubMed

Col JJ, Weinberg SL. The incidence and mortality of intraventricular conduction defects in acute myocardial infarction. Am J Cardiol. 1972 Mar;29(3):344-50. PubMed

Connolly SJ, Gent M, Roberts RS, Dorian P, Roy D, Sheldon RS, Mitchell LB, Green MS, Klein GJ, O'Brien B. Canadian implantable defibrillator study (CIDS): a randomized trial of the implantable cardioverter defibrillator against amiodarone. Circulation. 2000 Mar 21;101(11):1297-302. PubMed

Connolly SJ, Hallstrom AP, Cappato R, Schron EB, Kuck KH, Zipes DP, Greene HL, Boczor S, Domanski M, Follmann D, Gent M, Roberts RS. Meta-analysis of the implantable cardioverter defibrillator secondary prevention trials. AVID, CASH and CIDS studies. Antiarrhythmics vs Implantable Defibrillator study. Cardiac Arrest Study Hamburg. Canadian Implantable Defibrillator Study. Eur Heart J. 2000 Dec;21(24):2071-8. PubMed

Connolly SJ, Sheldon R, Thorpe KE, Roberts RS, Ellenbogen KA, Wilkoff BL, Morillo C, Gent M, VPS II Investigators. Pacemaker therapy for prevention of syncope in patients with recurrent severe vasovagal syncope: Second Vasovagal Pacemaker Study (VPS II): a randomized trial. JAMA. 2003 May 7;289(17):2224-9. PubMed

Den Dulk K, Bertholet M, Brugada P, Bar FW, Demoulin JC, Waleffe A, Bakels N, Lindemans F, Bourgeois I, Kulbertus HE, et al. Clinical experience with implantable devices for control of tachyarrhythmias. Pacing Clin Electrophysiol. 1984 May;7(3 Pt 2):548-56. PubMed

Denes P, Dhingra RC, Wu D, Wyndham CR, Amat-y-Leon F, Rosen KM. Sudden death in patients with chronic bifascicular block. Arch Intern Med. 1977 Aug;137(8):1005-10.

DePasquale NP, Bruno MS. Natural history of combined right bundle branch block and left anterior hemiblock (bilateral bundle branch block). Am J Med. 1973 Mar;54(3):297-303.

Desai AS, Fang JC, Maisel WH, Baughman KL. Implantable defibrillators for the prevention of mortality in patients with nonischemic cardiomyopathy: a meta-analysis of randomized controlled trials. JAMA. 2004 Dec 15;292(23):2874-9. [26 references] PubMed

Dewey RC, Capeless MA, Levy AM. Use of ambulatory electrocardiographic monitoring to identify high-risk patients with congenital complete heart block. N Engl J Med. 1987 Apr 2;316(14):835-9. PubMed

Dhingra RC, Denes P, Wu D, Chuquimia R, Amat-y-Leon F, Wyndham C, Rosen KM. Syncope in patients with chronic bifascicular block. Significance, causative mechanisms, and clinical implications. Ann Intern Med. 1974 Sep;81(3):302-6. PubMed

Dhingra RC, Denes P, Wu D, Chuquimia R, Rosen KM. The significance of second degree atrioventricular block and bundle branch block. Observations regarding site and type of block. Circulation. 1974 Apr;49(4):638-46.

Dhingra RC, Wyndham C, Bauernfeind R, Swiryn S, Deedwania PC, Smith T, Denes P, Rosen KM. Significance of block distal to the His bundle induced by atrial pacing in patients with chronic bifascicular block. Circulation. 1979 Dec;60(7):1455-64. PubMed

Domenighetti G, Perret C. Intraventricular conduction disturbances in acute myocardial infarction: short- and long-term prognosis. Eur J Cardiol. 1980 Jan;11(1):51-9. PubMed

Donmoyer TL, DeSanctis RW, Austen WG. Experience with implantable pacemakers using myocardial electrodes in the management of heart block. Ann Thorac Surg. 1967 Mar;3(3):218-27. PubMed

Donoso E, Adler LN, Friedberg CK. Unusual forms of second-degree atrioventricular block, including Mobitz type-II block, associated with the Morgagni-Adams-Stokes syndrome. Am Heart J. 1964;67:150-157.

Doshi RN, Daoud EG, Fellows C, Turk K, Duran A, Hamdan MH, Pires LA, PAVE Study Group. Left ventricular-based cardiac stimulation post AV nodal ablation evaluation (the PAVE study). J Cardiovasc Electrophysiol. 2005 Nov;16(11):1160-5. PubMed

Dreifus LS, Michelson EL, Kaplinsky E. Bradyarrhythmias: clinical significance and management. J Am Coll Cardiol. 1983 Jan;1(1):327-38. PubMed

Dubin AM, Berul CI, Bevilacqua LM, Collins KK, Etheridge SP, Fenrich AL, Friedman RA, Hamilton RM, Schaffer MS, Shah M, Silka MJ, Van Hare GF, Kertesz NJ. The use of implantable cardioverter-defibrillators in pediatric patients awaiting heart transplantation. J Card Fail. 2003 Oct;9(5):375-9. PubMed

Ector H, Rolies L, De Geest H. Dynamic electrocardiography and ventricular pauses of 3 seconds and more: etiology and therapeutic implications. Pacing Clin Electrophysiol. 1983 May;6(3 Pt 1):548-51. PubMed

Edhag O, Swahn A. Prognosis of patients with complete heart block or arrhythmic syncope who were not treated with artificial pacemakers. A long-term follow-up study of 101 patients. Acta Med Scand. 1976;200(6):457-63.

Eldar M, Griffin JC, Abbott JA, Benditt D, Bhandari A, Herre JM, Benson DW, Scheinman MM. Permanent cardiac pacing in patients with the long QT syndrome. J Am Coll Cardiol. 1987 Sep;10(3):600-7. PubMed

Eldar M, Griffin JC, Van Hare GF, Witherell C, Bhandari A, Benditt D, Scheinman MM. Combined use of beta-adrenergic blocking agents and long-term cardiac pacing for patients with the long QT syndrome. J Am Coll Cardiol. 1992 Oct;20(4):830-7. PubMed

Englund A, Bergfeldt L, Rehnqvist N, Astrom H, Rosenqvist M. Diagnostic value of programmed ventricular stimulation in patients with bifascicular block: a prospective study of patients with and without syncope. J Am Coll Cardiol. 1995 Nov 15;26(6):1508-15. PubMed

European Heart Rhythm Association, Heart Rhythm Society, Zipes DP, Camm AJ, Borggrefe M, Buxton AE, Chaitman B, Fromer M, Gregoratos G, Klein G, Moss AJ, Myerburg RJ, Priori SG, Quinones MA, Roden DM, Silka MJ, Tracy C, Smith SC, Jacobs AK, Adams CD, Antman EM, Anderson JL, Hunt SA, Halperin JL, Nishimura R, Ornato JP, Page RL, Riegel B, Priori SG, Blanc JJ, Budaj A, Camm AJ, Dean V, Deckers JW, Despres C, Dickstein K, Lekakis J, McGregor K, Metra M, Morais J, Osterspey A, Tamargo JL, Zamorano JL, American College of Cardiology, American Heart Association Task Force, European Society of Cardiology Committee for Practice Guidelines. ACC/AHA/ESC 2006 guidelines for management of patients with ventricular arrhythmias and the prevention of sudden cardiac death: a report of the American College of Cardiology/American Heart Association Task Force and the European Society of Cardiology Committee for Practice Guidelines (writing committee to develop guidelines for management of patients with ventricular arrhythmias and the prevention of sudden cardiac death). J Am Coll Cardiol. 2006 Sep 5;48(5):e247-346. PubMed

Ezri M, Lerman BB, Marchlinski FE, Buxton AE, Josephson ME. Electrophysiologic evaluation of syncope in patients with bifascicular block. Am Heart J. 1983 Oct;106(4 Pt 1):693-7. PubMed

Fananapazir L, Epstein ND, Curiel RV, Panza JA, Tripodi D, McAreavey D. Long-term results of dual-chamber (DDD) pacing in obstructive hypertrophic cardiomyopathy. Evidence for progressive symptomatic and hemodynamic improvement and reduction of left ventricular hypertrophy. Circulation. 1994 Dec;90(6):2731-42. PubMed

Fisch GR, Zipes DP, Fisch C. Bundle branch block and sudden death. Prog Cardiovasc Dis. 1980 Nov-Dec;23(3):187-224. [183 references]

Fisher JD, Johnston DR, Furman S, Mercando AD, Kim SG. Long-term efficacy of antitachycardia pacing for supraventricular and ventricular tachycardias. Am J Cardiol. 1987 Dec 1;60(16):1311-6. PubMed

Fisher JD, Teichman SL, Ferrick A, Kim SG, Waspe LE, Martinez MR. Antiarrhythmic effects of VVI pacing at physiologic rates: a crossover controlled evaluation. Pacing Clin Electrophysiol. 1987 Jul; 10(4 Pt 1):822-30. PubMed

Fisher JD. Role of electrophysiologic testing in the diagnosis and treatment of patients with known and suspected bradycardias and tachycardias. Prog Cardiovasc Dis. 1981 Jul-Aug;24(1):25-90. [452 references]

Freidberg CK, Donoso E, Stein WG. Nonsurgical acquired heart block. Ann N Y Acad Sci. 1964;111:835-847.

Gadboys HL, Wisoff BG, Litwak RS. Surgical treatment of complete heart block: an analysis of 36 cases. JAMA. 1964;189:97-102.

Gallagher JJ, Svenson RH, Kasell JH, German LD, Bardy GH, Broughton A, Critelli G. Catheter technique for closed-chest ablation of the atrioventricular conduction system. N Engl J Med. 1982 Jan 28;306(4):194-200.

Gammage M, Schofield S, Rankin I, Bennett M, Coles P, Pentecost B. Benefit of single setting rate responsive ventricular pacing compared with fixed rate demand pacing in elderly patients. Pacing Clin Electrophysiol. 1991 Feb;14(2 Pt 1):174-80. PubMed

Gasparini M, Auricchio A, Regoli F, Fantoni C, Kawabata M, Galimberti P, Pini D, Ceriotti C, Gronda E, Klersy C, Fratini S, Klein HH. Four-year efficacy of cardiac resynchronization therapy on exercise tolerance and disease progression: the importance of performing atrioventricular junction ablation in patients with atrial fibrillation. J Am Coll Cardiol. 2006 Aug 15;48(4):734-43. PubMed

Ginks WR, Sutton R, Oh W, Leatham A. Long-term prognosis after acute anterior infarction with atrioventricular block. Br Heart J. 1977 Feb;39(2):186-9. PubMed

Glikson M, Dearani JA, Hyberger LK, Schaff HV, Hammill SC, Hayes DL. Indications, effectiveness, and long-term dependency in permanent pacing after cardiac surgery. Am J Cardiol. 1997 Nov 15;80(10):1309-13. PubMed

Goel AK, Berger S, Pelech A, Dhala A. Implantable cardioverter defibrillator therapy in children with long QT syndrome. Pediatr Cardiol. 2004 Jul-Aug;25(4):370-8. PubMed

Goldenberg I, Mathew J, Moss AJ, McNitt S, Peterson DR, Zareba W, Benhorin J, Zhang L, Vincent GM, Andrews ML, Robinson JL, Morray B. Corrected QT variability in serial electrocardiograms in long QT syndrome: the importance of the maximum corrected QT for risk stratification. J Am Coll Cardiol. 2006 Sep 5;48(5):1047-52. PubMed

Goldstein NE, Lampert R, Bradley E, Lynn J, Krumholz HM. Management of implantable cardioverter defibrillators in end-of-life care. Ann Intern Med. 2004 Dec 7;141(11):835-8. PubMed

Gross GJ, Chiu CC, Hamilton RM, Kirsh JA, Stephenson EA. Natural history of postoperative heart block in congenital heart disease: implications for pacing intervention. Heart Rhythm. 2006 May;3(5):601-4. [19 references] PubMed

Hamilton RM, Dorian P, Gow RM, Williams WG. Five-year experience with implantable defibrillators in children. Am J Cardiol. 1996 Mar 1;77(7):524-6. PubMed

Hindman MC, Wagner GS, JaRo M, Atkins JM, Scheinman MM, DeSanctis RW, Hutter AH Jr, Yeatman L, Rubenfire M, Pujura C, Rubin M, Morris JJ. The clinical significance of bundle branch block complicating acute myocardial infarction. 2. Indications for temporary and permanent pacemaker insertion. Circulation. 1978 Oct;58(4):689-99.

Hiromasa S, Ikeda T, Kubota K, Hattori N, Nishimura M, Watanabe Y, Maldonado C, Palakurthy PR, Kupersmith J. Myotonic dystrophy: ambulatory electrocardiogram, electrophysiologic study, and echocardiographic evaluation. Am Heart J. 1987 Jun;113(6):1482-8. PubMed

Hobbs JB, Peterson DR, Moss AJ, McNitt S, Zareba W, Goldenberg I, Qi M, Robinson JL, Sauer AJ, Ackerman MJ, Benhorin J, Kaufman ES, Locati EH, Napolitano C, Priori SG, Towbin JA, Vincent GM, Zhang L. Risk of aborted cardiac arrest or sudden cardiac death during adolescence in the long-QT syndrome. JAMA. 2006 Sep 13;296(10):1249-54. PubMed

Jaeggi ET, Hamilton RM, Silverman ED, Zamora SA, Homberger LK. Outcome of children with fetal, neonatal or childhood diagnosis of

isolated congenital atrioventricular block, A single institution's experience of 30 years, J Am Coll Cardiol. 2002 Jan 2;39(1):130-7. PubMed-

James TN, Fisch C. Observations on the cardiovascular involvement in Friedriech's ataxia. Am Heart J. 1963;66:164-175.

James TN. Observations on the cardiovascular involvement, including the conduction system, in progressive muscular dystrophy. Am Heart J. 1962;63:48-56.

Johansson BW. Complete heart block. A clinical, hemodynamic and pharmacological study in patients with and without an artificial pacemaker. Acta Med Scand Suppl. 1966;451:1-127.

Josephson ME. Clinical cardiac electrophysiology: techniques and interpretations. 2nd ed. Philadelphia (PA): Lea & Febiger; 1993. 145 p.

Kadish A, Dyer A, Daubert JP, Quigg R, Estes NA, Anderson KP, Calkins H, Hoch D, Goldberger J, Shalaby A, Sanders WE, Schaechter A, Levine JH. Prophylactic defibrillator implantation in patients with nonischemic dilated cardiomyopathy. N Engl J Med. 2004 May 20;350(21):2151-8. [29 references] PubMed

Kammeraad JA, van Deurzen CH, Sreeram N, Bink-Boelkens MT, Ottenkamp J, Helbing WA, Lam J, Sobotka-Plojhar MA, Daniels O, Balaji S. Predictors of sudden cardiac death after Mustard or Senning repair for transposition of the great arteries. J Am Coll Cardiol. 2004 Sep 1;44(5):1095-102. PubMed

Kappenberger L, Linde C, Daubert C, McKenna W, Meisel E, Sadoul N, Chojnowska L, Guize L, Gras D, Jeanrenaud X, Ryden L. Pacing in hypertrophic obstructive cardiomyopathy. A randomized crossover study. PIC Study Group. Eur Heart J. 1997 Aug;18(8):1249-56. PubMed

Karamlou T, Silber I, Lao R, McCrindle BW, Harris L, Downar E, Webb GD, Colman JM, Van Arsdell GS, Williams WG. Outcomes after late reoperation in patients with repaired tetralogy of Fallot: the impact of arrhythmia and arrhythmia surgery. Ann Thorac Surg. 2006 May;81(5):1786-93; discussion 1793. PubMed

Kastor JA. Atrioventricular block (first of two parts). N Engl J Med. 1975 Feb 27;292(9):462-5. [25 references]

Kay R, Estioko M, Wiener I. Primary sick sinus syndrome as an indication for chronic pacemaker therapy in young adults: incidence, clinical features, and long-term evaluation. Am Heart J. 1982 Mar;103(3):338-42. PubMed

Kelly AM, Porter CJ, McGoon MD, Espinosa RE, Osborn MJ, Hayes DL. Breath-holding spells associated with significant bradycardia: successful treatment with permanent pacemaker implantation. Pediatrics. 2001 Sep;108(3):698-702. PubMed

Khairy P, Landzberg MJ, Gatzoulis MA, Lucron H, Lambert J, Marcon F, Alexander ME, Walsh EP. Value of programmed ventricular stimulation after tetralogy of fallot repair: a multicenter study. Circulation. 2004 Apr 27;109(16):1994-2000. PubMed

Kim MH, Deeb GM, Eagle KA, et al. Complete atrioventricular block after valvular heart surgery and the timing of pacemaker implantation. Am J Cardiol. 2001;87:649-651, A10.

Kim YH, O'Nunain S, Trouton T, Sosa-Suarez G, Levine RA, Garan H, Ruskin JN. Pseudo-pacemaker syndrome following inadvertent fast pathway ablation for atrioventricular nodal reentrant tachycardia. J Cardiovasc Electrophysiol. 1993 Apr;4(2):178-82. PubMed

Knight BP, Gersh BJ, Carlson MD, Friedman PA, McNamara RL, Strickberger SA, Tse HF, Waldo AL, American Heart Association Council on Clinical Cardiology (Subcommittee on, Quality of Care and Outcomes Research Interdisciplinary Working Group, Heart Rhythm Society, AHA Writing Group. Role of permanent pacing to prevent atrial fibrillation: science advisory from the American Heart Association

Council on Clinical Cardiology [trunc]. Circulation. 2005 Jan 18;111(2):240-3. [23 references] PubMed

Koplan BA, Stevenson WG, Epstein LM, Aranki SF, Maisel WH. Development and validation of a simple risk score to predict the need for permanent pacing after cardiac valve surgery. J Am Coll Cardiol. 2003 Mar 5;41(5):795-801. PubMed

Krongrad E. Prognosis for patients with congenital heart disease and postoperative intraventricular conduction defects. Circulation. 1978 May;57(5):867-70. [36 references]

Kuck KH, Cappato R, Siebels J, Ruppel R. Randomized comparison of antiarrhythmic drug therapy with implantable defibrillators in patients resuscitated from cardiac arrest: the Cardiac Arrest Study Hamburg (CASH). Circulation. 2000 Aug 15;102(7):748-54. PubMed

Kulbertus H, Collignon P. Association of right bundle-branch block with left superior or inferior intraventricular block. Its relation to complete heart block and Adams-Stokes syndrome. Br Heart J. 1969 Jul;31(4):435-40.

Kusumoto FM, Goldschlager N. Cardiac pacing, N Engl J Med. 1996 Jan 11;334(2):89-97. [53 references] PubMed

Lamas GA, Lee K, Sweeney M, Leon A, Yee R, Ellenbogen K, Greer S, Wilber D, Silverman R, Marinchak R, Bernstein R, Mittleman RS, Lieberman EH, Sullivan C, Zorn L, Flaker G, Schron E, Orav EJ, Goldman L. The mode selection trial (MOST) in sinus node dysfunction: design, rationale, and baseline characteristics of the first 1000 patients. Am Heart J. 2000 Oct;140(4):541-51. PubMed

Lamas GA, Muller JE, Turi ZG, Stone PH, Rutherford JD, Jaffe AS, Raabe DS, Rude RE, Mark DB, Califf RM, et al.. A simplified method to predict occurrence of complete heart block during acute myocardial infarction. Am J Cardiol. 1986 Jun 1;57(15):1213-9. PubMed

Langberg JJ, Chin MC, Rosenqvist M, Cockrell J, Dullet N, Van Hare G, Griffin JC, Scheinman MM. Catheter ablation of the atrioventricular junction with radiofrequency energy. Circulation. 1989 Dec;80(6):1527-35. PubMed

Levine SA, Miller H, Penton GB. Some clinical features of complete heart block. Circulation. 1956 Jun;13(6):801-24. PubMed

Lillehei CW, Sellers RD, Bonnabeau RC, Eliot RS. Chronic postsurgical complete heart block with particular reference reference to prognosis, management, and a new P-wave pacemaker. J Thorac Cardiovasc Surg. 1963 Oct;46:436-56. PubMed

Linde C, Abraham WT, Gold MR, St John Sutton M, Ghio S, Daubert C, REVERSE (REsynchronization reverses Remodeling in Systolic left vEntricular. Randomized trial of cardiac resynchronization in mildly symptomatic heart failure patients and in asymptomatic patients with left ventricular dysfunction and previous heart failure symptoms. J Am Coll Cardiol. 2008 Dec 2;52(23):1834-43. PubMed

Linde-Edelstam C, Nordlander R, Pehrsson SK, Ryden L. A double-blind study of submaximal exercise tolerance and variation in paced rate in atrial synchronous compared to activity sensor modulated ventricular pacing. Pacing Clin Electrophysiol. 1992 Jun;15(6):905-15. PubMed

Maron BJ, Nishimura RA, McKenna WJ, Rakowski H, Josephson ME, Kieval RS. Assessment of permanent dual-chamber pacing as a treatment for drug-refractory symptomatic patients with obstructive hypertrophic cardiomyopathy. A randomized, double-blind, crossover study (M-PATHY). Circulation. 1999 Jun 8;99(22):2927-33. PubMed

McAlister HF, Klementowicz PT, Andrews C, Fisher JD, Feld M, Furman S. Lyme carditis: an important cause of reversible heart block. Ann Intern Med. 1989 Mar 1;110(5):339-45. [48 references] PubMed

McAnulty JH, Kauffman S, Murphy E, Kassebaum DG, Rahimtoola SH. Survival in patients with intraventricular conduction defects. Arch Intern Med. 1978 Jan;138(1):30-5.

McAnulty JH, Rahimtoola SH, Murphy E, DeMots H, Ritzmann L, Kanarek PE, Kauffman S. Natural history of "high-risk" bundle-branch block: final report of a prospective study. N Engl J Med. 1982 Jul 15;307(3):137-43. PubMed

Michaelsson M, Jonzon A, Riesenfeld T. Isolated congenital complete atrioventricular block in adult life. A prospective study. Circulation. 1995 Aug 1;92(3):442-9. PubMed

Moak JP, Barron KS, Hougen TJ, Wiles HB, Balaji S, Sreeram N, Cohen MH, Nordenberg A, Van Hare GF, Friedman RA, Perez M, Cecchin F, Schneider DS, Nehgme RA, Buyon JP. Congenital heart block: development of late-onset cardiomyopathy, a previously underappreciated sequela. J Am Coll Cardiol. 2001 Jan;37(1):238-42. PubMed

Monnig G, Kobe J, Loher A, Eckardt L, Wedekind H, Scheld HH, Haverkamp W, Milberg P, Breithardt G, Schulze-Bahr E, Bocker D. Implantable cardioverter-defibrillator therapy in patients with congenital long-QT syndrome: a long-term follow-up. Heart Rhythm. 2005;2(5):497-504. PubMed

Morady F, Higgins J, Peters RW, Schwartz AB, Shen EN, Bhandari A, Scheinman MM, Sauve MJ. Electrophysiologic testing in bundle branch block and unexplained syncope. Am J Cardiol. 1984 Sep 1;54(6):587-91. PubMed

Moss AJ, Hall WJ, Cannom DS, Daubert JP, Higgins SL, Klein H, Levine JH, Saksena S, Waldo AL, Wilber D, Brown MW, Heo M, Multicenter Automatic Defibrillator Implantation Trial Investigators. Improved survival with an implanted defibrillator in patients with coronary disease at high risk for ventricular arrhythmia. N Engl J Med. 1996 Dec 26;335(26):1933-40. PubMed

Moss AJ, Hall WJ, Cannom DS, Klein H, Brown MW, Daubert JP, Estes NA 3rd, Foster E, Greenberg H, Higgins SL, Pfeffer MA, Solomon SD, Wilber D, Zareba W, MADIT-CRT Trial Investigators. Cardiac-resynchronization therapy for the prevention of heart-failure events. N Engl J Med. 2009 Oct 1;361(14):1329-38. PubMed

Moss AJ, Robinson J. Clinical features of the idiopathic long QT syndrome. Circulation. 1992 Jan;85(1 Suppl):I140-4. [16 references] PubMed

Moss AJ, Zareba W, Hall WJ, Klein H, Wilber DJ, Cannom DS, Daubert JP, Higgins SL, Brown MW, Andrews ML. Prophylactic implantation of a defibrillator in patients with myocardial infarction and reduced ejection fraction. N Engl J Med. 2002 Mar 21;346(12):877-83. PubMed

Mushlin AI, Hall WJ, Zwanziger J, Gajary E, Andrews M, Marron R, Zou KH, Moss AJ. The cost-effectiveness of automatic implantable cardiac defibrillators: results from MADIT. Multicenter Automatic Defibrillator Implantation Trial. Circulation. 1998 Jun 2;97(21):2129-35. PubMed

Mymin D, Mathewson FA, Tate RB, Manfreda J. The natural history of primary first-degree atrioventricular heart block. N Engl J Med. 1986 Nov 6;315(19):1183-7. PubMed

Nishimura RA, Hayes DL, Ilstrup DM, Holmes DR Jr, Tajik AJ. Effect of dual-chamber pacing on systolic and diastolic function in patients with hypertrophic cardiomyopathy. Acute Doppler echocardiographic and catheterization hemodynamic study. J Am Coll Cardiol. 1996 Feb;27(2):421-30. PubMed

Nishimura RA, Symanski JD, Hurrell DG, Trusty JM, Hayes DL, Tajik AJ. Dual-chamber pacing for cardiomyopathies: a 1996 clinical perspective. Mayo Clin Proc. 1996 Nov;71(11):1077-87. [47 references] PubMed

Nishimura RA, Trusty JM, Hayes DL, Ilstrup DM, Larson DR, Hayes SN, Allison TG, Tajik AJ. Dual-chamber pacing for hypertrophic cardiomyopathy: a randomized, double-blind, crossover trial. J Am Coll Cardiol. 1997 Feb;29(2):435-41. PubMed

Perloff JK, Stevenson WG, Roberts NK, Cabeen W, Weiss J. Cardiac involvement in myotonic muscular dystrophy (Steinert's disease): a prospective study of 25-patients. Am J Cardiol. 1984 Nov 1;54(8):1074-81. PubMed

Peters RW, Scheinman MM, Modin C, O'Young J, Somelofski CA, Mies C. Prophylactic permanent pacemakers for patients with chronic bundle branch block. Am J Med. 1979 Jun;66(6):978-85. PubMed

Peters RW, Scheinman MM, Morady F, Jacobson L. Long-term management of recurrent paroxysmal tachycardia by cardiac burst pacing. Pacing Clin Electrophysiol. 1985 Jan;8(1):35-44. PubMed

Pfammatter JP, Paul T, Lehmann C, Kallfelz HC. Efficacy and proarrhythmia of oral sotalol in pediatric patients. J Am Coll Cardiol. 1995 Oct;26(4):1002-7. PubMed

Pinsky WW, Gillette PC, Garson A Jr, McNamara DG. Diagnosis, management, and long-term results of patients with congenital complete atrioventricular block. Pediatrics. 1982;69:728-733. PubMed

Probst P, Pachinger O, Akbar Murad A, Leisch F, Kaindl F. The HQ time in congestive cardiomyopathies. Am Heart J. 1979 Apr;97(4):436-41.

Ranganathan N, Dhurandhar R, Phillips JH, Wigle ED. His Bundle electrogram in bundle-branch block. Circulation. 1972 Feb;45(2):282-94.

Rasmussen K. Chronic sinus node disease: natural course and indications for pacing. Eur Heart J. 1981 Dec;2(6):455-9. PubMed

Recommendations for pacemaker prescription for symptomatic bradycardia. Report of a working party of the British Pacing and Electrophysiology Group. Br Heart J. 1991 Aug;66(2):185-91. PubMed

Reiffel JA, Kuehnert MJ. Electrophysiological testing of sinus node function: diagnostic and prognostic application-including updated information from sinus node electrograms. Pacing Clin Electrophysiol. 1994 Mar;17(3 Pt 1):349-65. [83 references] PubMed

Rickard J, Bassiouny M, Cronin EM, Martin DO, Varma N, Niebauer MJ, Tchou PJ, Tang WH, Wilkoff BL. Predictors of response to cardiac resynchronization therapy in patients with a non-left bundle branch block morphology. Am J Cardiol. 2011 Dec 1;108(11):1576-80. PubMed

Ritter WS, Atkins JM, Blomqvist CG, Mullins CB. Permanent pacing in patients with transient trifascicular block during acute myocardial infarction. Am J Cardiol. 1976 Aug;38(2):205-8.

Roberts NK, Perloff JK, Kark RA. Cardiac conduction in the Kearns-Sayre syndrome (a neuromuscular disorder associated with progressive external ophthalmoplegia and pigmentary retinopathy). Report of 2 cases and review of 17 published cases. Am J Cardiol. 1979 Dec;44(7):1396-400. PubMed

Rubenstein JJ, Schulman CL, Yurchak PM, DeSanctis RW. Clinical spectrum of the sick sinus syndrome. Circulation. 1972 Jul;46(1):5-13.

Saksena S, Delfaut P, Prakash A, Kaushik RR, Krol RB. Multisite electrode pacing for prevention of atrial fibrillation. J Cardiovasc Electrophysiol. 1998 Aug;9(8 Suppl):S155-62. [16 references] PubMed

Saksena S, Pantopoulos D, Parsonnet V, Rothbart ST, Hussain SM, Gielchinsky I. Usefulness of an implantable antitachycardia pacemaker system for supraventricular or ventricular tachycardia. Am J Cardiol. 1986 Jul 1;58(1):70-4. PubMed

Saksena S, Prakash A, Hill M, Krol RB, Munsif AN, Mathew PP, Mehra R. Prevention of recurrent atrial fibrillation with chronic dual-site right atrial pacing. J Am Coll Cardiol. 1996 Sep;28(3):687-94. [28 references] PubMed

Scheinman MM, Peters RW, Modin G, Brennan M, Mies C, O'Young J. Prognostic value of infranodal conduction time in patients with chronic bundle branch block. Circulation. 1977 Aug;56(2):240-4.

Scheinman MM, Peters RW, Suave MJ, Desai J, Abbott JA, Cogan J, Wohl B, Williams K. Value of the H-Q interval in patients with bundle branch block and the role of prophylactic permanent pacing. Am J Cardiol. 1982 Dec;50(6):1316-22. PubMed

Shaw DB, Holman RR, Gowers JI. Survival in sinoatrial disorder (sick-sinus syndrome). BMJ. 1980 Jan 19;280(6208):139-41.

Shaw DB, Kekwick CA, Veale D, Gowers J, Whistance T. Survival in second degree atrioventricular block. Br Heart J. 1985 Jun;53(6):587-93. PubMed

Sheldon R, Koshman ML, Wilson W, Kieser T, Rose S. Effect of dual-chamber pacing with automatic rate-drop sensing on recurrent neurally mediated syncope. Am J Cardiol. 1998 Jan 15;81(2):158-62. PubMed

Shohat-Zabarski R, Iakobishvili Z, Kusniec J, Mazur A, Strasberg B. Paroxysmal atrioventricular block: clinical experience with 20 patients. Int J Cardiol. 2004 Dec;97(3):399-405. PubMed

Sholler GF, Walsh EP. Congenital complete heart block in patients without anatomic cardiac defects. Am Heart J. 1989 Dec;118(6):1193-8. PubMed

Siebels J, Kuck KH. Implantable cardioverter defibrillator compared with antiarrhythmic drug treatment in cardiac arrest survivors (the Cardiac Arrest Study Hamburg). Am Heart J. 1994 Apr;127(4 Pt 2):1139-44. PubMed

Silka MJ, Kron J, Dunnigan A, Dick M 2nd. Sudden cardiac death and the use of implantable cardioverter-defibrillators in pediatric patients. The Pediatric Electrophysiology Society. Circulation. 1993 Mar;87(3):800-7. PubMed

Silka MJ, Manwill JR, Kron J, McAnulty JH. Bradycardia-mediated tachyarrhythmias in congenital heart disease and responses to chronic pacing at physiologic rates. Am J Cardiol. 1990 Feb 15;65(7):488-93. PubMed

Stephenson EA, Casavant D, Tuzi J, Alexander ME, Law I, Serwer G, Strieper M, Walsh EP, Berul CI. Efficacy of atrial antitachycardia pacing using the Medtronic AT500 pacemaker in patients with congenital heart disease. Am J Cardiol. 2003 Oct 1;92(7):871-6. PubMed

Stevenson WG, Perloff JK, Weiss JN, Anderson TL. Facioscapulohumeral muscular dystrophy: evidence for selective, genetic electrophysiologic cardiac involvement. J Am Coll Cardiol. 1990 Feb;15(2):292-9. PubMed

Strasberg B, Amat-Y-Leon F, Dhingra RC, Palileo E, Swiryn S, Bauernfeind R, Wyndham C, Rosen KM. Natural history of chronic second-degree atrioventricular nodal block. Circulation. 1981 May;63(5):1043-9. PubMed

Sutton R, Brignole M, Menozzi C, Raviele A, Alboni P, Giani P, Moya A. Dual-chamber pacing in the treatment of neurally mediated tilt-positive cardioinhibitory syncope: pacemaker versus no therapy: a multicenter randomized study. The Vasovagal Syncope International Study (VASIS) Investigators. Circulation. 2000 Jul 18;102(3):294-9. PubMed

Tang AS, Wells GA, Talajic M, Arnold MO, Sheldon R, Connolly S, Hohnloser SH, Nichol G, Birnie DH, Sapp JL, Yee R, Healey JS, Rouleau JL, Resynchronization-Defibrillation for Ambulatory Heart Failure Trial Investigators. Cardiac-resynchronization therapy for mild-to-moderate heart failure. N Engl J Med. 2010 Dec 16;363(25):2385-95. PubMed

Twidale N, Heddle WF, Ayres BF, Tonkin AM. Clinical implications of electrophysiology study findings in patients with chronic bifascicular block and syncope. Aust N Z J Med. 1988 Dec;18(7):841-7. PubMed

Upadhyay GA, Choudhry NK, Auricchio A, Ruskin J, Singh JP. Cardiac resynchronization in patients with atrial fibrillation: a meta-analysis of prospective cohort studies. J Am Coll Cardiol. 2008 Oct 7;52(15):1239-46. PubMed

Vatankulu MA, Goktekin O, Kaya MG, Ayhan S, Kucukdurmaz Z, Sutton R, Henein M. Effect of long-term resynchronization therapy on left ventricular remodeling in pacemaker patients upgraded to biventricular devices. Am J Cardiol. 2009 May 1;103(9):1280-4. PubMed

Villain E, Coastedoat-Chalumeau N, Marijon E, Boudjemline Y, Piette JC, Bonnet D. Presentation and prognosis of complete atrioventricular block in childhood, according to maternal antibody status. J Am Coll Cardiol. 2006 Oct 17;48(8):1682-7. PubMed

Villain E, Ouarda F, Beyler C, Sidi D, Abid F. [Predictive factors for late complete atrio-ventricular block after surgical treatment for congenital cardiopathy. Arch Mal Coeur Vaiss. 2003 May;96(5):495-8. PubMed

Viskin S, Alla SR, Barron HV, Heller K, Saxon L, Kitzis I, Hare GF, Wong MJ, Lesh MD, Scheinman MM. Mode of onset of torsade de pointes in congenital long QT syndrome. J Am Coll Cardiol. 1996 Nov 1;28(5):1262-8. PubMed

Viskin S. Implantable cardioverter defibrillator in high-risk long QT syndrome patients. J Cardiovasc Electrophysiol. 2003 Oct;14(10):1130-1; reply 1131. PubMed

Weindling SN, Saul JP, Gamble WJ, Mayer JE, Wessel D, Walsh EP. Duration of complete atrioventricular block after congenital heart disease surgery. Am J Cardiol. 1998 Aug 15;82(4):525-7. PubMed

Wever EF, Hauer RN, van Capelle FL, Tijssen JG, Crijns HJ, Algra A, Wiesfeld AC, Bakker PF, Robles de Medina EO. Randomized study of implantable defibrillator as first-choice therapy versus conventional strategy in postinfarct sudden death survivors. Circulation. 1995 Apr 15;91(8):2195-203. PubMed

Wilkoff BL, Cook JR, Epstein AE, Greene HL, Hallstrom AP, Hsia H, Kutalek SP, Sharma A. Dual-chamber pacing or ventricular backup pacing in patients with an implantable defibrillator: the Dual Chamber and VVI Implantable Defibrillator (DAVID) Trial. JAMA. 2002 Dec 25;288(24):3115-23. PubMed

Wilton SB, Leung AA, Ghali WA, Faris P, Exner DV. Outcomes of cardiac resynchronization therapy in patients with versus those without atrial fibrillation: a systematic review and meta-analysis. Heart Rhythm. 2011 Jul;8(7):1088-94. PubMed

Zareba W, Moss AJ, Daubert JP, Hall WJ, Robinson JL, Andrews M. Implantable cardioverter defibrillator in high-risk long QT syndrome patients. J Cardiovasc Electrophysiol. 2003 Apr;14(4):337-41. PubMed

Zeltser D, Justo D, Halkin A, Rosso R, Ish-Shalom M, Hochenberg M, Viskin S. Drug-induced atrioventricular block: prognosis after discontinuation of the culprit drug. J Am Coll Cardiol. 2004 Jul 7;44(1):105-8. PubMed

Zipes DP. Second-degree atrioventricular block. Circulation. 1979 Sep;60(3):465-72. [64 references] PubMed

Type of Evidence Supporting the Recommendations

The type of supporting evidence is identified and graded for each recommendation (see the "Major Recommendations" field).

The recommendations listed in this document are, whenever possible, evidence based.

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

- Appropriate use of cardiac pacemakers and implantable cardioverter-defibrillators (ICDs)
- Improved effectiveness of care, optimal outcomes, and appropriate use of resources
- Decreased morbidity and mortality in patients requiring implantation of cardiac pacemakers or ICDs

Potential Harms

- Recent evidence suggests that ventricular desynchronization due to right ventricular apical (RVA) pacing may have adverse effects on left ventricular (LV) and left atrial structure and function. These adverse effects likely explain the association of RVA pacing, independent of atrioventricular synchrony, with increased risks of atrial fibrillation and heart failure in randomized clinical trials of pacemaker therapy and, additionally, ventricular arrhythmias and death during implantable cardioverter-defibrillator (ICD) therapy.
- Cardiac resynchronization therapy device defibrillation capabilities (CRT-D) was associated with a higher risk of adverse device- or implantation-related complications at 30 days after implantation (probability [p] <0.001) compared with an ICD and no cardiac resynchronization therapy (CRT).
- Studies have suggested that chronic RVA pacing in young patients, primarily those with congenital complete heart block, can lead to
 adverse histological changes, LV dilation, and LV dysfunction.
- Conventional ICD therapy in any form may be associated with worsening heart failure, ventricular tachycardia, ventricular fibrillation, and noncardiac death that can be related to the adverse effects of RVA pacing.
- Complications related to replacement of ICD generators under advisory have been well documented, including infection, the need for
 reoperation, and death. The estimated device failure rate and the likelihood of mortality resulting from device failure must be weighed against
 the risk of procedural morbidity and mortality associated with device replacement.
- The use of ICD therapy carries a risk for psychological consequences and may lead to a decrement on quality of life, especially among
 patients who have experienced shocks. Reports of significant behavioral disorders, including anxiety, device dependence, or social
 withdrawal, have been described with ICD implantation.
- Thoracotomy in fragile patients with heart failure has been associated with bleeding, stroke, hypotension, and arrhythmias.
- · Cardiac resynchronization devices and ICDs are not infallible; failure of electronics, batteries, and leads can occur.

Contraindications

Contraindications

A prosthetic mechanical tricuspid valve represents an absolute contraindication to placement of transvenous right ventricular leads, because such leads will cross the valve and may interfere with valve function. This scenario occurs commonly in patients with tricuspid valve endocarditis and a transvenous pacemaker.

Qualifying Statements

Qualifying Statements

- It is important that the medical profession play a significant role in critically evaluating the use of diagnostic procedures and therapies as they
 are introduced and tested in the detection, management, or prevention of disease states. Rigorous and expert analysis of the available data
 documenting absolute and relative benefits and risks of those procedures and therapies can produce helpful guidelines that improve the
 effectiveness of care, optimize patient outcomes, and favorably affect the overall cost of care by focusing resources on the most effective
 strategies.
- The American College of Cardiology Foundation/American Heart Association (ACCF/AHA) practice guidelines are intended to assist healthcare providers in clinical decision making by describing a range of generally acceptable approaches to the diagnosis, management, and

prevention of specific diseases or conditions. The guidelines attempt to define practices that meet the needs of most patients in most circumstances. The ultimate judgment about care of a particular patient must be made by the healthcare provider and patient in light of all the circumstances presented by that patient. As a result, situations may arise in which deviations from these guidelines may be appropriate. Clinical decision making should consider the quality and availability of expertise in the area where care is provided. When these guidelines are used as the basis for regulatory or payer decisions, the goal should be improvement in quality of care. The Task Force recognizes that situations arise in which additional data are needed to inform patient care more effectively; these areas will be identified within each respective guideline when appropriate.

Prescribed courses of treatment in accordance with these recommendations are effective only if they are followed. Because lack of patient
understanding and adherence may adversely affect outcomes, physicians and other healthcare providers should make every effort to engage
the patient's active participation in prescribed medical regimens and lifestyles. In addition, patients should be informed of the risks, benefits,
and alternatives to a particular treatment and should be involved in shared decision making whenever feasible, particularly for class of
recommendation IIa and IIb, for which the benefit-to-risk ratio may be lower.

Implementation of the Guideline

Description of Implementation Strategy

An implementation strategy was not provided.

Implementation Tools

Clinical Algorithm

Pocket Guide/Reference Cards

Slide Presentation

For information about availability, see the Availability of Companion Documents and Patient Resources fields below.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

End of Life Care

Getting Better

Living with Illness

IOM Domain

Effectiveness

Patient-centeredness

Identifying Information and Availability

Bibliographic Source(s)

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Adaptation

Not applicable: The guideline was not adapted from another source.

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Guideline Developer(s)

American College of Cardiology Foundation - Medical Specialty Society

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*The 2012 writing group members were required to recuse themselves from voting on sections to which their specific relationships with industry and other entities may apply; see Appendix 4 in the original guideline document for recusal information.

Financial Disclosures/Conflicts of Interest

The Task Force makes every effort to avoid actual, potential, or perceived conflicts of interest that may arise as a result of industry relationships or personal interests among the members of the writing group. All writing group members and peer reviewers of the guideline are required to disclose all current healthcare—related relationships, including those existing 12 months before initiation of the writing effort.

For the 2008 guidelines, all members of the writing committee, as well as peer reviewers of the document, were asked to provide disclosure statements of all such relationships that may be perceived as real or potential conflicts of interest. Writing committee members are also strongly encouraged to declare a previous relationship with industry that may be perceived as relevant to guideline development.

In December 2009, the American College of Cardiology Foundation (ACCF) and the American Heart Association (AHA) implemented a new policy for relationships with industry and other entities (RWI) that requires the writing group chair plus a minimum of 50% of the writing group to have no *relevant* RWI (Appendix 4 of the original guideline document includes the ACCF/AHA definition of *relevance*). These statements are reviewed by the Task Force and all members during each conference call and/or meeting of the writing group and are updated as changes occur. All guideline recommendations require a confidential vote by the writing group and must be approved by a consensus of the voting members. Members may not draft or vote on any text or recommendations pertaining to their RWI. The 2012 members who recused themselves from voting are indicated in the list of writing group members, and specific section recusals are noted in Appendix 4 of the original guideline document. 2008 and 2012 authors' and peer reviewers' RWI pertinent to this guideline are disclosed in Appendixes 1, 2, 4, and 5 of the original guideline document, respectively. Additionally, to ensure complete transparency, writing group members' comprehensive disclosure information—including RWI not pertinent to this document—is available as an online supplement. Comprehensive disclosure information for the Task Force is also available online at http://cardiosource.org/ACC/About-ACC/Who-We-Are/Leadership/Guidelines-and-Documents-Task-Forces.aspx

Guideline Endorser(s)

American Association of Thoracic Surgery - Medical Specialty Society

Heart Failure Society of America, Inc - Disease Specific Society

Society of Thoracic Surgeons - Medical Specialty Society

Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: Epstein AE, DiMarco JP, Ellenbogen KA, Estes NA 3rd, Freedman RA, Gettes LS, Gillinov AM, Gregoratos G, Hammill SC, Hayes DL, Hlatky MA, Newby LK, Page RL, Schoenfeld MH, Silka MJ, Stevenson LW, Sweeney MO, Smith SC Jr, Jacobs AK, Adams CD, Anderson JL, Buller CE, Creager MA, Ettinger SM, Faxon DP, Halperin JL, Hiratzka LF, Hunt SA, Krumholz HM, Kushner FG, Lytle BW, Nishimura RA, Ornato JP, Page RL, Riegel B, Tarkington LG, Yancy CW, American College of Cardiology/American Heart Association Task Force on Practice, American Association for Thoracic Surgery, Society of Thoracic Surgeons. ACC/AHA/HRS 2008 guidelines for device-based therapy of cardiac rhythm abnormalities: a report of the American College of Cardiology/American Heart Association task force [trunc]. J Am Coll Cardiol. 2008 May 27;51(21):e1-62.

Guideline Availability Electronic copies: Available from the Journal of the American College of Cardiology (JACC) Web site and the Circulation Web site Print copies: Available from the American College of Cardiology, 2400 N Street NW, Washington DC, 20037; (800) 253-4636 (US only). Availability of Companion Documents The following are available: • Methodology manual and policies from the ACCF/AHA Task Force on Practice Guidelines. 2010 Jun. 88 p. American College of Cardiology Foundation and American Heart Association, Inc. Electronic copies: Available in Portable Document Format (PDF) from the American College of Cardiology (ACC) Web site 2012 ACCF/AHA/HRS focused update incorporated into the ACCF/AHA/HRS 2008 guidelines for device-based therapy of cardiac rhythm abnormalities. A report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines and the Heart Rhythm Society. Data supplement. 2013. 5 p. Electronic copies: Available from the Circulation Web site 2012 ACCF/AHA/HRS focused update incorporated into the ACCF/AHA/HRS 2008 guidelines for device-based therapy of cardiac rhythm abnormalities. A report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines and the Heart Rhythm Society. Slide set. 2013. 80 p. Electronic copies: Available to subscribers from the ACC Web site ACC/AHA pocket guideline. Device-based therapy of cardiac rhythm abnormalities. Electronic copies: Available to subscribers from the ACC Web site • Top ten things to know. Device-based therapy of cardiac rhythm abnormalities. 2012. 1 p. AHA/American Stroke Association. Electronic copies: Available to subscribers from the ACC Web site Print copies: Available from the American College of Cardiology, 2400 N Street NW, Washington DC, 20037; (800) 253-4636 (US only).

Patient Resources

None available

NGC Status

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